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ADAPTIVE PROCESSING EXPERIMENT (APE) PHASE II

ROME AIR DEVELOPMENT CENTER
GRIFFISS AIR FORCE BASE, NEW YORK

MAY 1976

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ADAPTIVE PROCESSING EXPERIMENT (APE) PHASE II

Technology Service Corporation

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ROME AIR DEVELOPMENT CENTER
AIR FORCE SYSTEMS COMMAND
GRIFFISS AIR FORCE BASE, NEW YORK 13441

This report has been reviewed by the RADC Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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control and communications areas.

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EVALUATION

This contractual effort was performed in support of the RADC-ESD OTH
Technology Program (TPO 6). This effort represents the initial investi-
gations into the use and expected performance of digital beamforming and
adaptive beamforming techniques, both hardware and software, for OTH
radar receive systems. The achievement of very low sidelobe antennas and
decreased ECM vulnerability of OTH radars will depend upon the use of these
techniques. The concepts, hardware, and software employed in and developed
through this effort are being incorporated into RADC's Ava/Dexter experi-
mental OTH Radar Facility.

WILLIAM F. McCULLOUGH, Capt USAF
Project Engineer

1.0   INTRODUCTION AND CONCLUSIONS

BACKGROUND

Extensive interest has developed in the last several years over the possibility of spatial filtering, whereby an antenna's aperture illumination function is adaptively controlled to produce pattern nulls in the direction of undesired interference. Implicit in the ability to adaptively control the illumination function, however, is the requirement to measure the structure of the spatial interference. This in turn necessitates a multiplicity of receivers--one for each adaptive degree of freedom in the system.

SYSTEM DEGRADATION

Many types of systematic errors (e.g., element spacing mismatch, variation in element pattern mismatch, mutual coupling, etc.) even when not known a priori, can be automatically compensated for in an adaptive beamforming network. Element-to-element receiver mismatch on the other hand imposes an inherent limitation on the achievable beam pattern sidelobe level as well as the achievable cancellation ratio against a broadband interference source. This problem becomes acute when the pulse length of the transmitted waveform approaches a small fraction of the aperture size. In such cases a point interference source has an effective spatial spread proportional to the receiver bandwidth. Both the sidelobe level and the achievable cancellation ratio against broad-band interference sources are degraded when the receiver mismatch is uncompensated. Section 3.0 quantifies this degradation as a function of the amount of receiver mismatch.

CONCLUSIONS

The receiver equalization technique employed is to solve for the set of weights in a tapped delay line transversal filter that minimizes the mean square error residue between a reference receiver's frequency response and the response of any other receiver. The conclusions of the study are as follows.

1.   Systems Degradation - The achievable sidelobe level and the cancellation ratio against broadband interference sources may be seriously degraded by receiver mismatch.

2. <u>Sidelobe Level</u> - The achievable peak response to RMS sidelobe level is given by:

$$R = \frac{G}{|E|^2}$$ (1)

where

G = antenna gain

$|E|^2$ = normalized mean square error residue.

(Equation (1) of Section 3.0)

3. <u>Transversal Filter Performance</u> - The achievable improvement in $|E|^2$, the normalized mean square error residue is quantified in Section 4.0 as a function of the tap spacing and number of taps in the transversal filter.

For 16 taps spaced at $\tau = \frac{1}{2.5B}$, where (B) is the 3 dB receiver bandwidth, the improvement is over 30 dB. Indeed it was found that $|E|^2$ decreased from approximately -(30-35 dB) to -63 dB. This latter figure is also the noise floor of the calibration system as corroborated by spectral analysis.

4. <u>Receiver Error Sources</u> - The primary source of receiver mismatch was probably pole location errors. This is strongly suggested by the fact that the receiver transfer function has 8 complex poles (6 pole Butterworth plus 2 additional poles) and that 16 real taps reduced the error residue to negligible proportions.

2.0 TSC EFFORTS

Sections 3.0 through 6.0 of this report describe the engineering services performed by Technology Service Corporation (TSC) under Contract No. F30602-75-C-0264 to RADC, Griffiss Air Force Base, Rome, New York, in support of their Adaptive Processing Program - Phase II.

The scope of the effort consisted of three major tasks. The first task was to examine the impact of receiver passband phase and amplitude tracking errors on the performance of a radar system using digital beamforming. Secondly, we wished to develop a potential solution to the receiver tracking problem and, thirdly, it was desired to evaluate the effectiveness of the candidate solution in reducing the impact of the errors on system performance.

3.0 PERFORMANCE DEGRADATION DUE TO RECEIVER MISMATCH

BACKGROUND

There are two deleterious effects caused by receiver mismatch in a multi-channel beam forming network; sidelobe degradation and the inability to cancel point source wideband interference via spatial nulls.

3.1 Sidelobe Degradation

The most reasonable model for receiver mismatch is to assume that each receiver's frequency response is the sum of an ideal unperturbed response and a noise like error term in both phase and amplitude. This model is also obtained if one assumes that the primary reason for the mismatch is a random error in the pole locations of the filters. It will be shown that, without receiver equalization, the achievable peak response to RMS sidelobe level with any aperture weighting is limited to:

$$R = \geq \frac{G}{|E|^2}$$

Where:

R = Peak response to RMS sidelobe ratio

G = Antenna gain

$|E|^2$ = Normalized mean square error residue between any two receivers

Assume that (N) receivers (R_i) are used to form a beam with a set of deterministic weights (W_i), ($1 \leq i \leq N$). Then assuming that the normalized error power between any two receivers is $|E|^2$, viz:

$$|E|^2_{ik} = \frac{\int_0^\infty |R_i - R_k|^2 dx}{\int |R_i|^2 dx} \tag{1}$$

Where:

R_i and R_k are the outputs of receivers (i) and (k) respectively, and the variable of integration (x), denotes frequency from a wideband interference source. (Wide bandwidth is construed to mean larger bandwidth than the receiver pass-band.)

The output of the beam forming network at any in-band frequency (x) is given by:

$$B_p = \sum_{i=1}^{N} W_i R_{i_p} = \sum_{i=1}^{N} W_i (R_i + EN_i) \qquad (2)$$

Where:

R_i = Output of receiver (i) with no error

R_{i_p} = Output of error perturbed receiver (i)

N_i = Zero mean, unit variance Gaussian variable

E = Normalized RMS error defined by (1)

then for a linear array with spacing (d)

$$R_i = \exp\left[j\left(\frac{2\pi d x_i}{c} \right) \sin\theta \right] \qquad (3)$$

Where:

C = Velocity of light

θ = Angle of wideband interference off of boresite

since $N_i N_k = 0$ for $i \neq k$, it follows that at all in band frequencies (x), the frequency response in voltage is given by:

$$B_p(x) = \sum_{i=1}^{N} W_i \exp\left[\frac{j 2\pi d x_i}{c} \sin\theta \right] + EN_0 \left(\sum_{i=1}^{N} |W_i|^2 \right)^{1/2} \qquad (4)$$

Where:

N_0 = Zero mean unit variance Gaussian variable.

The mean response in power is given by:

$$\overline{H_p(x)} = H_c(x) + |E|^2 \sum_{i=1}^{N} |W_i|^2 \qquad (5)$$

Where:

$\overline{H_p(x)}$ = Expected value of the perturbed response

$H_c(x)$ = Ideal response with no receiver mismatch

The error perturbation term is completely broadband [independent of the frequency (x)].

The achievable peak response to RMS sidelobe level is then limited by the broadband error term viz:

$$R = \frac{H_c \text{ (Boresite)}}{H_c(x) + |E|^2 \sum_{i=1}^{N} |W_i|^2} \qquad (6)$$

or

$$\overline{R} = \frac{\left(\sum_{i=1}^{N} W_i\right)^2}{H_c(x) + |E|^2 \sum_{i=1}^{N} |W_i|^2} \qquad (7)$$

$\left(\sum_{i=1}^{N} W_i\right)^2 / \sum_{i=1}^{N} |W_i|^2$ is the antenna gain at boresite and

$H_c(x)$ may be made arbitrarily small by proper choice of the deterministic weighting function, it follows that the peak response to RMS sidelobe level is given by:

$$\overline{R} \gtrsim \frac{G}{|E|^2} \qquad (8)$$

Where:

G = Antenna gain

$|E|^2$ = Normalized error power given by (1)

3.2 Adaptive Cancellation

It is apparent that in addition to limiting the achievable sidelobe level--receiver mismatch precludes any possibility of adaptively forming a deep spatial null. Since the error term in (5) is broadband, it is impossible to spatially cancel it. (See Appendix H.)

4.0 RECEIVER MATCHING

BACKGROUND

This section derives a transversal filter to be used on a given receiver such that it "optimally" tracks a reference receiver. The criterion of optimality in this case is that the normalized mean power residue between the receivers be as small as possible for a given number of transversal filter taps and spacing.

The actual receivers used in the RADC system were 6 pole Butterworth filters. As such the computer program was organized to align both theoretically derived 6 pole Butterworth filters and the actual receivers measured by Raytheon.

4.1 Analysis

Each element of the receiving array feeds a separate amplifier and A/D converter. The digital outputs from the element channels are then combined in a digital processor which performs the functions of beamforming and pulse compression. The amplifiers in the individual array element channels must be carefully matched in order to achieve low antenna sidelobe levels over the entire frequency band. This section describes a method of matching amplifier transfer functions very accurately, utilizing a digital transversal filter in each channel.

The technique for matching the channel responses is illustrated schematically in Figure 4-1. The analog amplifier in each channel will be represented by a Butterworth filter in the following analysis. At the output of this filter, the signal $y_k(t)$ is converted to digital form, where each digital sample is a complex number retaining both amplitude and phase information. The subscript k on the variable of Figure 4-1 represents the channel number. A set of consecutive samples of each $y_k(t)$ is weighted and added as shown in Figure 4-1. The delay line, weighting multipliers, and adder in Figure 4-1 comprise a transversal filter for matching the channel response. The channel-to-channel match is achieved by selection of the set of weights, W_{kn}. The following analysis outlines a method of achieving a least-mean-square match between two channels by optimum choice of the W_{kn}.
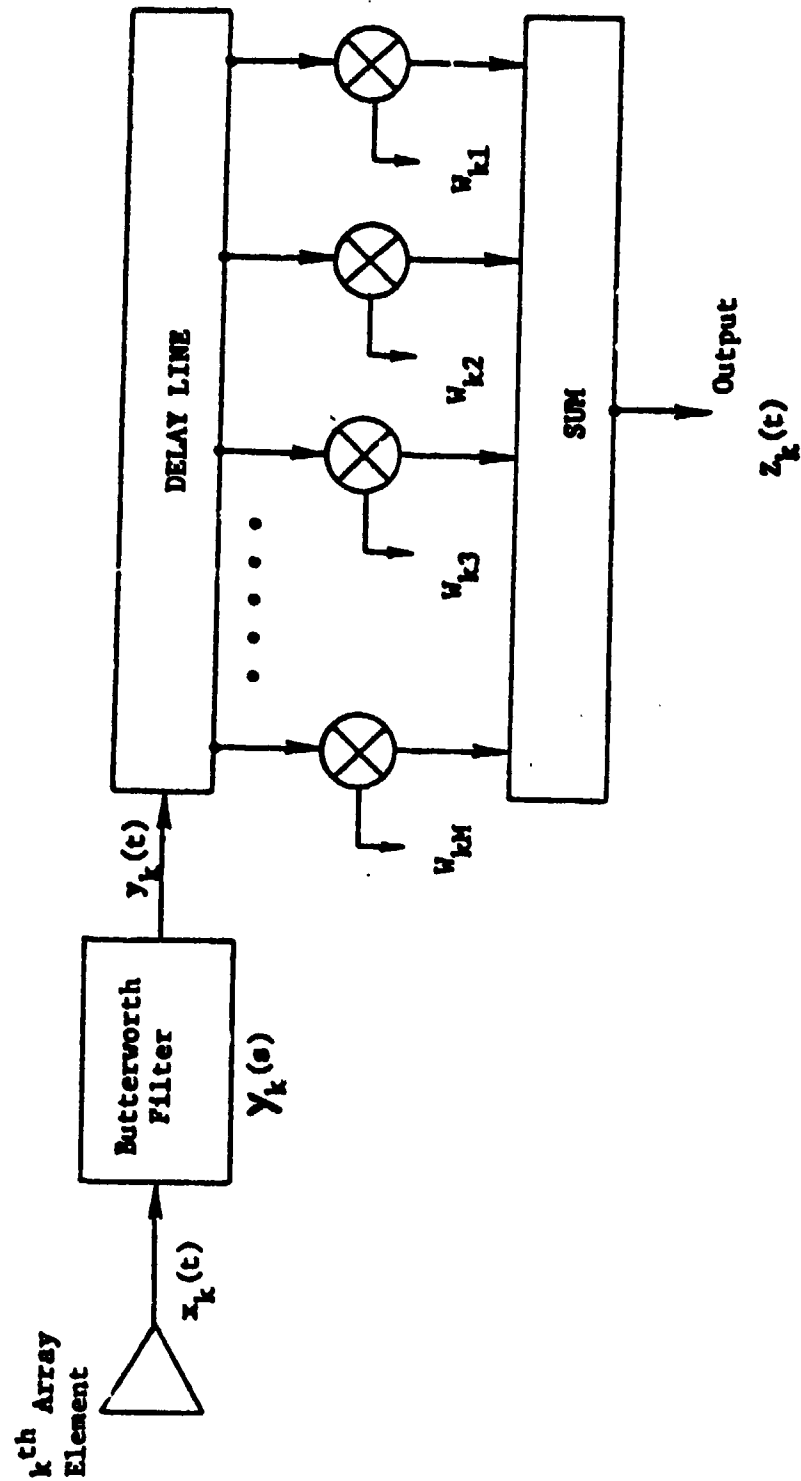
Figure 4-1. Schematic of Equalizing Circuit

In the following discussion, two channels will be considered: a reference channel (k=1), and a second channel (k=2) in which the weights are to be optimized. It is assumed that the Butterworth filter response in the reference channel is that of an ideal N-pole filter given by:

$$Y_1(s) = \left(\frac{B}{2}\right)^N \prod_{n=1}^{8} \frac{1}{(s-s_{1n})} \tag{1}$$

Where:

$s = j2\pi f$

f = frequency

$s_{1n} = n^{th}$ pole $= B/2 \exp\left\{j\pi\left(\frac{1}{2} + \frac{2n-1}{2N}\right)\right\}$

B = filter bandwidth

An alternative representation of this transfer function is

$$Y_1(s) = \sum_{n=1}^{N} \frac{A_{1n}}{(s-s_{1n})}$$

$$\tag{2}$$

$$A_{1n} = \left(\frac{B}{2}\right)^N \prod_{\substack{j=1 \\ j \neq n}}^{N} \frac{1}{(s_{1n}-s_{1j})}$$

The impulse response of this filter is

$$h_1(t) = \sum_{n=1}^{N} A_{1n} e^{s_{1n}t} \tag{3}$$

The filter in channel 2 is represented by the same expansion (Equations 1, 2, and 3), except that the poles in the second channel are in error and differ from the reference channel poles by a few percent.

The output of the transversal filter in channel k is

$$z_k(t) = \sum_{m=1}^{M} W_{km} \, y_k \, (t-m\tau) \tag{4}$$

Where:

   τ = spacing between taps

   M = number of taps in each delay line.

While it is convenient to represent this transversal filter by continuous functions of time (Equation 4), it should be recalled that this signal processing will be performed digitally. The transversal filter in the reference channel can be used to narrow the channel passband by weighting all taps, e.g., with Chebyschev weights to achieve low sidelobes. If all tap weights are zero except for one, the transversal filter introduces a delay but does not change the overall channel response. In the following analysis, both cases are included since tapped delay lines are assumed in both channels 1 and 2. The examples consider the case where all channel 1 taps are zero except the center tap, i.e., the case where the transversal filter in channel 2 is used to match the channel 2 response to the Butterworth filter of channel 1.

   To compute optimum weights, W_{2n}, assume that the same signal is fed into channels 1 and 2. It is convenient to consider wideband white noise, $n(t)$, as this input, although a set of signals across the receiver passband will suffice. For the input $x_k(t) = n(t)$, the Butterworth filter output is

$$y_k(t) = \int_0^{\infty} n(t-u) h_k(u) du$$

$$= \sum_{n=1}^{N} A_{kn} \int_0^{\infty} e^{s_{kn} u} \, n(t-u) du \tag{5}$$

The transversal filter output in the kth channel, from Equations 4 and 5, is

$$z_k(t) = \sum_{m=1}^{M} W_{km} \sum_{n=1}^{N} A_{kn} \int_0^{\infty} e^{s_{kn} u} \, n(t-u-m\tau) du \tag{6}$$

The weights in channel 2, W_{2n}, are selected to minimize the noise power in the difference $z_2(t)-z_1(t)$.

$$P = E \{|z_2(t)-z_1(t)|^2\} \tag{7}$$

where E denotes the expectation or average.

This expression has the following form

$$P = E\{z_2^*(t)z_2(t)-z_2^*(t)z_1(t)-z_2(t)z_1^*(t)+z_1^*(t)z_1(t)\}$$

$$= W_2^{*T}M_2W_2 - W_2^{*T}M_{12}W_1 - W_2^TM_{12}^*W_1^* + W_1^{*T}M_1W_1 \tag{8}$$

Where:

W_k = column vector of weights W_{kn}

*   denotes complex conjugate

T   denotes transpose

M_k = covariance matrix with elements $M_k(m,n)$

$M_k(m,n) = E\{y_k^*(t-m\tau)y_k(t-n\tau)\}$

M_{12} = matrix with elements $E\{y_1^*(t-m\tau)y_2(t-n\tau)\}$

The derivation of Equation 8 can be illustrated by expanding the first term

$$E\{Z_k^*(t)Z_k(t)\} = E\left\{\sum_{m=1}^{N} \sum_{m'=1}^{N} \sum_{n=1}^{N} \sum_{n'=1}^{N} W_{km}^* W_{km'} A_{kn}^* A_{km'} \right.$$

$$\int_0^\infty du_1 \int_0^\infty du_2 \ e^{(s_{km}^* u_1 + s_{km'} u_2)} \tag{9}$$

$$\left. n^*(t-u_1-m\tau)n(t-u_2-m'\tau)\right\}$$

This is a quadratic form $W_k^{*T}M_kW_k$, where the elements of M are

$$M_k(m,m') = E\left\{ \sum_{n,n'=1}^{N} A_{kn}^* A_{kn'} \int_0^\infty \int_0^\infty n^*(t-u_1-m\tau)n(t-u_2-m'\tau) \right.$$
$$\left. e^{(s_{kn}^* u_1 + s_{kn'} u_2)} du_1 du_2 \right\} \tag{10}$$

Consider a white noise process, $n(t)$, for which

$$E \; n^*(t)n(t+\tau) = \delta(\tau) \tag{11}$$

The elements of the matrix M_k, from Equation 10, are

$$M_k(m,m') = \sum_{n,n'=1}^{N} A_{kn}^* A_{kn'} \int_0^\infty e^{s_{kn}^* u_1 + s_{kn'}(u_1 + m\tau - m'\tau)} du_1 \tag{12}$$

$$= -\sum_{n,n'=1}^{N} \frac{A_{kn}^* A_{kn'}}{(s_{kn}^* + s_{kn'})} e^{s_{kn'}(m-m')\tau} \; ; \; m \geq m'$$

Note that in deriving Equation 12, both $u_1 \geq 0$ and $u_2 \geq 0$, so this equation is correct only when $m \geq m'$. When $m \leq m'$

$$M_k(m,m') = -\sum_{n,n'=1}^{N} \frac{A_{kn}^* A_{kn'}}{(s_{kn}^* + s_{kn'})} e^{s_{kn}^*(m'-m)\tau} \quad m \leq m' \tag{12a}$$

In performing the above integrations, note that Real $(s_{kn}) < 0$. Similar expressions can be derived for the cross-covariance matrix in Equation 8, M_{12}.

Next we select a set of weights for the transversal filter in channel 2, W_2, which minimizes the noise power in the output, $Z_2(t)-Z_1(t)$. This output power is given by Equation 8, where the covariance matrices are computed for white noise into the two filters. The set of weights, W_2, which

minimizes P of Equation 8 also provides the best least-mean-square fit of the two channel responses.

The set of weights which minimizes Equation 8 is

$$W_2 = M_2^{-1} M_{12} W_1 \qquad (13)$$

For these weights, a small perturbation in the W_{2n}, denoted by the column vector δW_2, gives $\delta P = 0$.

$$\delta P = \delta W_2^{*T}(M_2 W_2 - M_{12} W_1) + (W_2^{*T} M_2 - W_1^{*T} M_{12}^{*T}) \delta W_2 \qquad (14)$$

$$= 0 \text{ when Equation 13 is satisfied.}$$

When the weights W_2 satisfy Equation 13, the power in the output $[Z_2(t) - Z_1(t)]$ is

$$P = W_1^{*T} M_1 W_1 - W_2^T M_{12}^* W_1^* \qquad (15)$$

The method outlined in this section was used to match the receiver channels in the OTH receiving array. Since the filter outputs are available in digital form, the various covariance matrices in Equation 13 were computed from sample data. It has been shown[1] that, when weights are computed directly from a sample covariance matrix as suggested above, a modest number of data samples will provide an excellent estimate of the optimum weights. The number of samples in the sample covariance matrix required to achieve within 3 dB of the LMS residue is roughly $N_s = 2N$, where N_s = number of samples and N = number of taps.

Note that the expression $M_{12} W_1$ in Equation 13 can be obtained directly by cross-correlating the channel 2 tap outputs with the output $Z_1(t)$ of channel 1.

The following sections contain examples of this filter matching technique. Results show that excellent filter match can be obtained by optimizing weights on the digital transversal filters.

(1)   I. S. Reed, J. D. Mallett, and L. E. Brennan, "Rapid Convergence Rate in Adaptive Arrays," to appear in IEEE Trans. AES.

4.2 Example of Filter Matching

A FORTRAN program was written to obtain quantitative estimates of the filter matching which can be achieved as a function of several parameters, viz., number of taps, tap spacing, and initial mismatch. Results have been very encouraging. One example is detailed here to show that sufficiently accurate channel matching can be achieved for the OTH receiving array to meet antenna sidelobe specifications. The program used in these studies is listed in Appendix F.

The reference filter of channel 1 is an 8-pole Butterworth filter with poles equally spaced along a circle in the left half of the s-plane. Filter 2 is obtained by displacing each of the 8 poles by a randomly generated amount from the ideal pole location of channel 1. Each s_{n2} is obtained from the corresponding s_{n1} by

$$s_{n2} = s_{n1} (1 + .03r) \tag{16}$$

where r is a random number uniformly distributed on the interval $(-1,1)$ and having a uniformly distributed random phase on $(0,2\pi)$. The pole locations for the two filters are shown in Table 1. The coefficients A_{kn} for each filter were computed from Equation 2.

In this particular example, the 3 dB bandwidth of filter 1 is 100 Hz. The initial mismatch, R_o, between the two filters was computed by numerical integration.

$$R_o = \int_{-B/2}^{B/2} |Y_2(s)-Y_1(s)|^2 df \bigg/ \int_{-B/2}^{B/2} |Y_1(s)|^2 df \tag{17}$$

In this example $R_o = .0015$. The rms phase error between the two filters, averaged over the interval $(-B/2, B/2)$, i.e., between the 3 dB points of filter 1, was 1.27°.

The preceding equations were then used to compute an optimum set of tap weights for channel 2. The response of the channel 1 Butterworth filter was not modified by the transversal filter in this channel, i.e., all tap weights except one in channel 1 were set to zero. The resulting tap weights for the 2 channels are shown in Table 2.

Table 1. Poles of Butterworth Filters

Reference Channel 1				Channel 2			
Real		**Imaginary**		**Real**		**Imaginary**	
-6.128	E+02	3.081	E+02	-6.017	E+02	3.065	E+02
-1.745	E+02	2.612	E+02	-1.745	E+02	2.551	E+02
-2.612	E+02	1.745	E+02	-2.597	E+02	1.814	E+02
-3.081	E+02	6.128	E+02	-3.088	E+02	6.036	E+01
-3.081	E+02	-8.128	E+01	-3.084	E+02	-6.132	E+01
-2.612	E+02	-1.745	E+02	-2.557	E+02	-1.733	E+02
-1.745	E+02	-2.612	E+02	-1.698	E+02	-2.620	E+02
-6.128	E+01	-3.081	E+02	-6.565	E+01	-3.081	E+02

Table 2. Optimum Tap Weights

	Channel 1		Channel 2	
	Real	**Imaginary**	**Real**	**Imaginary**
1	0.000	0.000	.00009	-.00003
2	0.000	0.000	-.00021	.00007
3	0.000	0.000	.00038	-.00013
4	0.000	0.000	-.00064	.00021
5	0.000	0.000	.00102	-.00033
6	0.000	0 000	-.00171	.00051
7	0.000	0.000	.00335	-.00082
8	1.000	0.000	.98030	.00330
9	0.000	0.000	-.02163	-.01159
10	0.000	0.000	.00813	.00685
11	0.000	0.000	.00404	.00290
12	0.000	0.000	-.00359	-.00684
13	0.000	0.000	.00021	.00482
14	0.000	0.000	.00165	-.00105
15	0.000	0.000	-.00156	-.00096
16	0.000	0.000	.00069	.00093

The spacing between taps in this particular example was $\tau = .7/B$. Sixteen tap weights were optimized. The mismatch after optimization of the transversal filter in channel 2 was reduced by 34.2 dB. The normalized mean square residue, as in Equation 17 with $Y_k(s)$ representing the product of Butterworth and transversal filters, was reduced to 5.6×10^{-7}. The rms phase error after matching was reduced to $.02°$.

This example illustrates the excellent channel-to-channel match which can be achieved using digital transversal filters in each channel. The FORTRAN program can be used to explore other cases of interest.

4.3 Alignment of RADC Receivers

The equations used for obtaining the optimum weights from the measured data supplied by RADC are listed below.

Definitions

I_s^k = Output of receiver (k) measured at frequency (X_s) at output of FFT (in phase component)

Q_s^k = Same for quadrature component

τ = Tap spacing

$$\bar{w}_K = \begin{pmatrix} w_1 \\ w_2 \\ \vdots \\ w_N \end{pmatrix} = \text{Adaptive weight vector for receiver (k)}$$

$$\bar{\delta} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} = \text{Weight vector for reference receiver (middle tap = 1)}$$

$N = 2L + 1 = \#$ of taps (odd)[*]

$R = \#$ receivers

$(1 \le K \le R)$ (Complex receivers)

$R = 16$ nominal

$P = \#$ measured frequencies

$(1 \le s \le P)$ $P = 20$ nominal

---

[*]   For mathematical convenience only. The calculations could be carried through with an even number of taps also.

STEPS FOR ADAPTIVE PROCESSING

GIVEN	AMPLITUDE	PHASE
I_s^k	$A_s^k(I)$	$\phi_s^k(I)$
Q_s^k	$A_s^k(Q)$	$\phi_s^k(Q)$

$$1 \leq k \leq 16$$

$$1 \leq s \leq 20 \quad , \quad \text{15-110 Hz at 5 Hz increments}$$

1. **60 Hz Reference Alignment**

   Amplitude Alignment

$$A_s^k(I)_{NEW} = A_s^k(I) \bullet \frac{A_{60\ Hz}^1(I)}{A_{60\ Hz}^k(I)} \tag{1}$$

$$A_s^k(Q)_{NEW} = A_s^k(Q) \bullet \frac{A_{60\ Hz}^1(I)}{A_{60\ Hz}^k(Q)} \tag{2}$$

   Phase Alignment

$$\phi_s^k(I)_{NEW} = \phi_s^k(I) + \phi_{60\ Hz}^1(I) - \phi_{60\ Hz}^k(I) \tag{3}$$

$$\phi_s^k(Q)_{NEW} = \phi_s^k(Q) + \phi_{60\ Hz}^1(I) - \phi_{60\ Hz}^k(Q) \tag{4}$$

2. **Complex Receiver Formation**

   Let

$$I_{s\ NEW}^k = \textcircled{I}_s^k$$

$$Q_{s\ NEW}^k = \textcircled{Q}_s^k$$

The outputs of the (i^{th}) tap for tap spacing (τ) is

$$\textcircled{I}_s^k(i\tau) = A_s^k(I)_{NEW} \cos[\phi_s^k(I)_{NEW} + 2\pi\ x_s(i\tau)] \tag{5}$$

$$\left(Q\right)_s^k (i\tau) = A_s^k (Q)_{NEW} \cos\left[\phi_s^k (Q)_{NEW} + 2\pi x_s (i\tau)\right], \quad (0 \leq i \leq 2L) \qquad (6)$$

$$\left(Z\right)_s^k (i\tau) = \left(I\right)_s^k (i\tau) + j \left(Q\right)_s^k (i\tau) \qquad (7)$$

Let

$$\left(\overline{Z}\right)_s^k = \begin{pmatrix} \left(Z\right)_s^k (0) \\ \left(Z\right)_s^k (\tau) \\ \cdot \\ \cdot \\ \cdot \\ \left(Z\right)_s^k (i\tau) \end{pmatrix} \qquad (8)$$

= complex receiver output (H_k) for frequency (x_s)

ADAPTATION

Definitions:

$$\overline{w}_K = \begin{pmatrix} 1 \\ w_2 \\ w \\ \cdot \\ \cdot \\ \cdot \\ w_{2L+1} \end{pmatrix}_K$$ = Adaptive weight vector for receiver (K)

$$\overline{\delta} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1_L \\ 0 \\ 0 \\ 0 \end{pmatrix}$$ = Weight vector for reference receiver (middle tap = 1)

M_{kk} = Covariance matrix for receiver (K) output

M_{rr} = Covariance matrix for reference output

M_{kr} = Cross covariance matrix of receive (K) and reference

From (8)

$$M_{kk} = \sum_{s=1}^{P} \overrightarrow{\textcircled{2}}_s^k \; \overrightarrow{\textcircled{2}}_s^k \tag{9}$$

$$M_{rr} = \sum_{s=1}^{P} \overrightarrow{\textcircled{2}}_s^r \; \overrightarrow{\textcircled{2}}_s^r \tag{10}$$

$$M_{kr} = \sum_{s=1}^{P} \overrightarrow{\textcircled{2}}_s^k \; \overrightarrow{\textcircled{2}}_s^r \tag{11}$$

Adaptive Weight Formation

$$\overline{W}_k \; (\text{opt}) = M_{kk}^{-1} \; M_{kr} \; \overline{\delta} \tag{12}$$

Mean Square Error Residue

$\textcircled{R}_k$ = Mean normalized square power residue
   for filter (k) after adaptation

R_k = Normalized mean square power residue before adaptation

Residue After Adaptation

$$\textcircled{R}_k = \frac{\overline{\delta}^* \left[M_{rr} - M_{kr}^{-1} M_{kk} M_{kr}^{-1} \right] \overline{\delta}}{\overline{\delta}^* M_{rr} \overline{\delta}} \tag{13}$$

Residue Prior to Adaptation

$$R_k = \frac{\sum_{s=1}^{P} \left[\overrightarrow{\textcircled{2}}_s^k - \overrightarrow{\textcircled{2}}_s^r \right] \left[\overrightarrow{\textcircled{2}}_s^k - \overrightarrow{\textcircled{2}}_s^r \right]}{\overline{\delta}^* M_{rr} \overline{\delta}} \tag{14}$$

5.0 RESULTS

5.1 RADC Receiver Data

The method described in Section 4.0 was applied to the RADC Dexter data
acquisition system. This system consists of 32 homodyne receivers configured
as 16 complex receivers with I&Q outputs. Each receiver output (I&Q) has its
own I.F. filter with a nominal bandwidth of 15 to 110 Hz. Measurements
were taken of the phase and amplitude responses of all 32 receiver channels
by stepping a synthesizer across the passband of all channels simul-
taneously and recording the sampled outputs on magnetic tape. A 256
point FFT was then run on each channel and phase and amplitudes calculated
from the outputs. The amplitude response of Receiver #1, I-channel, is
shown in Figure 5-1. Using this channel as a reference, all other receiver
channels were compared with it and error curves in both phase and amplitude
were computed. An example of this is shown in Figure 5-2 where the phase
and amplitude errors between Receiver #2, I-channel and the reference are
plotted. (It should be noted that in all cases the channels were exactly
matched at the 60-Hz point in the passband. This can be done with no loss
in generality.) The object of the optimization is to minimize the total
error power. The magnitude of the complex error vector is plotted for the
above example in Figure 5-3. To get a single measure of the error magni-
tude, this is integrated over the bandwidth and normalized. The final
measure is error power out of the reference channel for a white noise input.
(It is a measure of total distortion.) For the example given, this number
is -30.39 dB. In a similar manner, the normalized error was computed for
all other receivers and channels using Receiver #1, I-channel, as the refer-
ence. This result is shown in Figure 5-4. If the error is averaged over
all the receivers, a net mismatch can be calculated. For the data shown,
this is -31.78 dB.

The achievable improvement in the error was computed by designing
filters of various lengths (4, 8, 12, 16 taps) and computing the residual
error remaining at the output of the filter. To illustrate this, the

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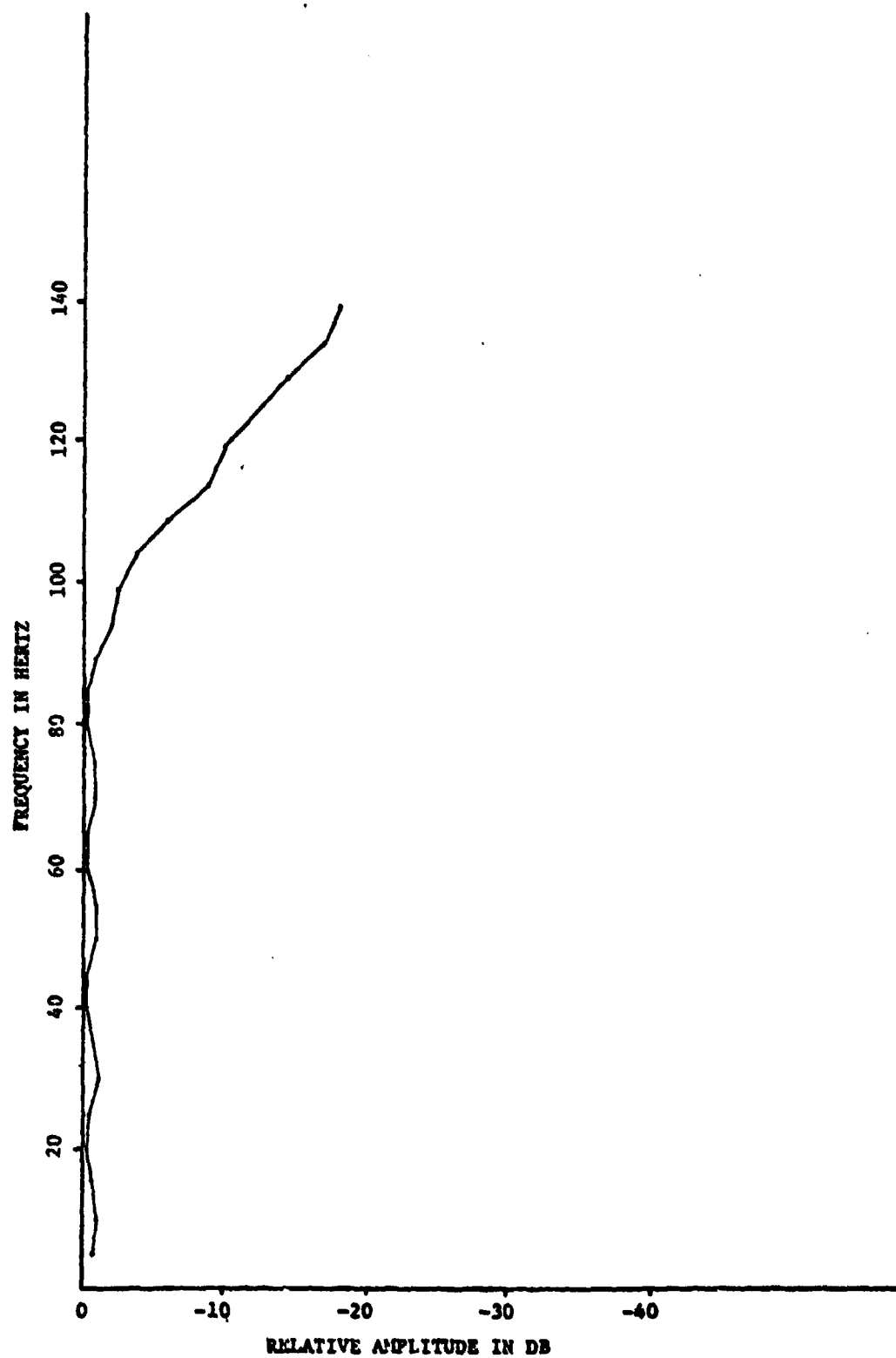
Figure 5-1. Amplitude Response of Receiver #1, I-Channel

Amplitude Error

Relative Amplitude in dB

+.5dB

0

-.5dB

20 40 60 80 100 120

Frequency in Hertz

Relative Phase in Degrees

+2°

0

-2°
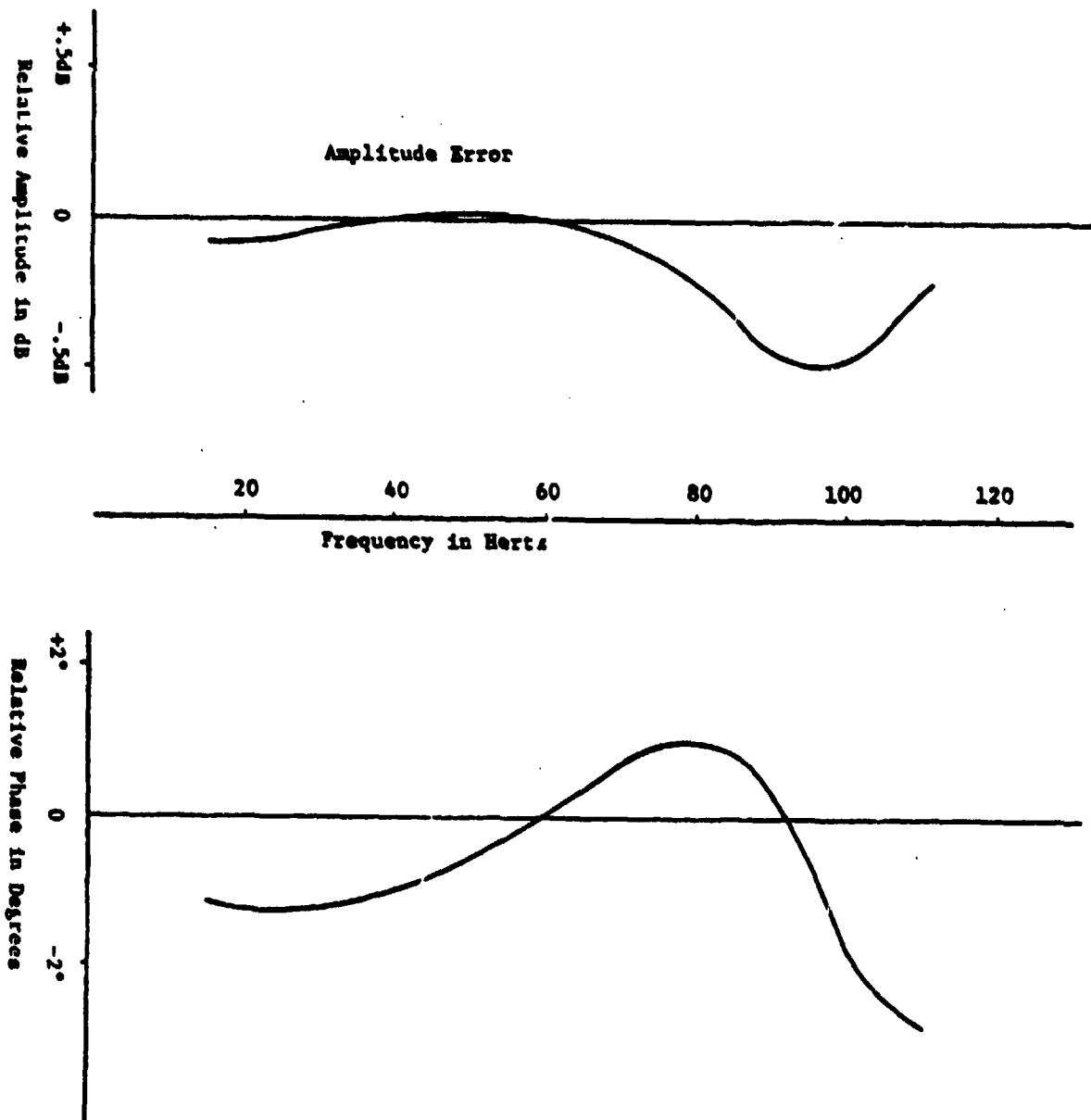
Figure 5-2. Amplitude and Phase Errors vs. Frequency for
Receiver #1, I-Channel and Receiver #2, I-Channel

Frequency in Hertz
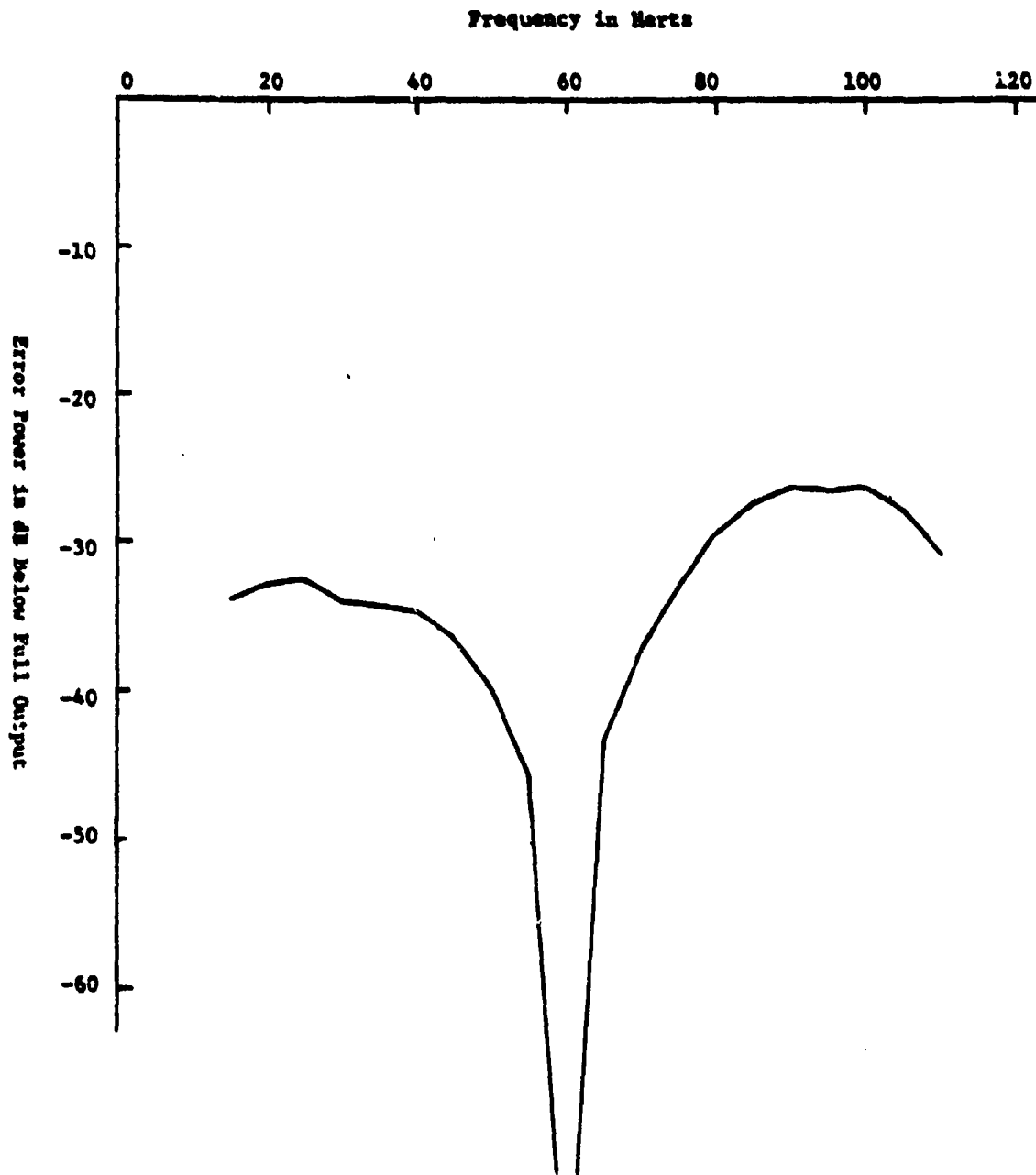
Figure 5-3. Error Power versus Frequency for
            Receiver #1, I-Channel vs. Receiver #2, I-Channel
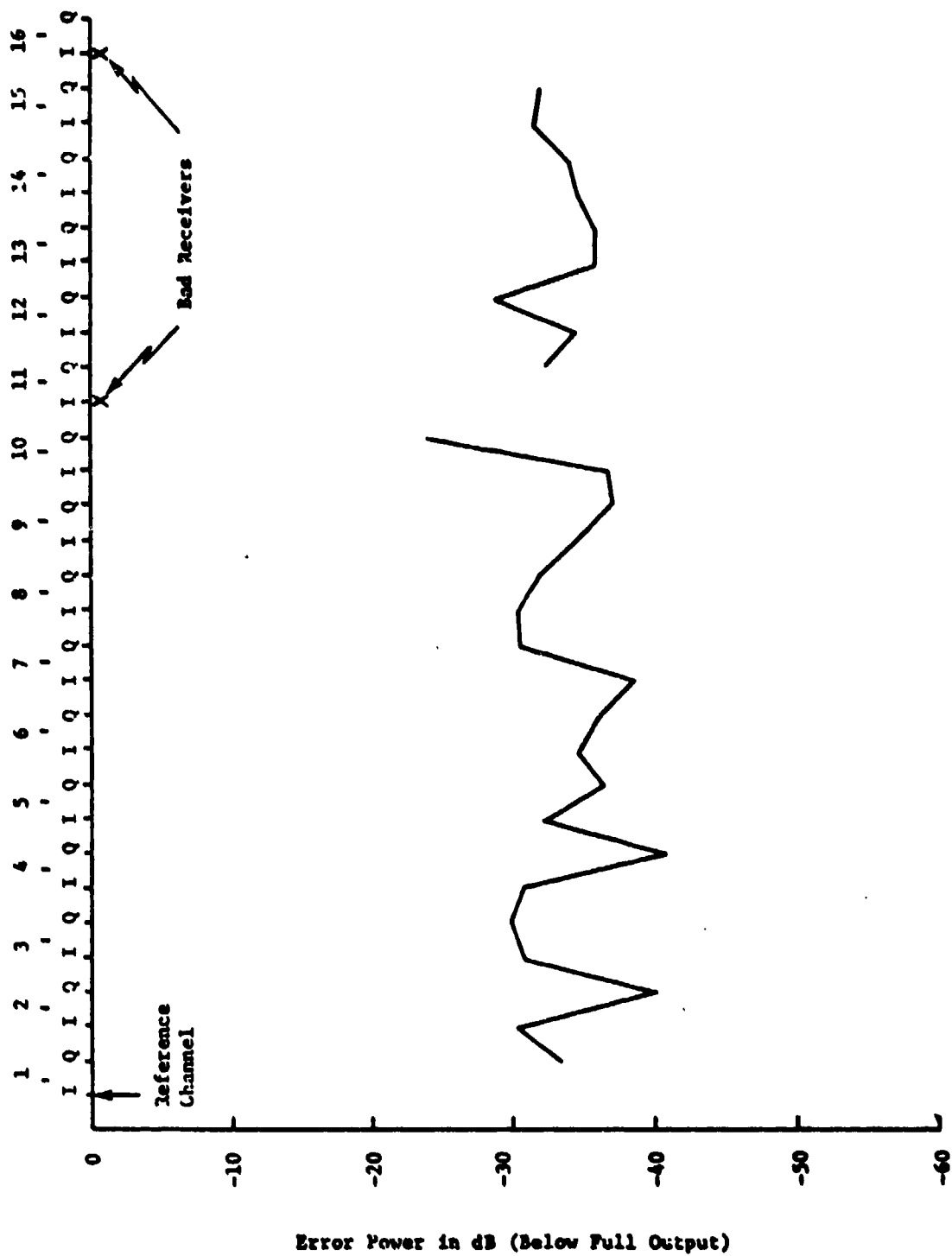
Figure 5-4. Error Power versus Receiver Channel

example of Figure 5-2 will be used. Taking Receiver #1, I-channel, as the reference and Receiver #2, I-channel as the channel to be matched to the reference, an 8-tap filter was designed. The phase and amplitude errors remaining after the filter, are shown in Figure 5-5, along with the input errors for comparison. When these numbers were converted to power and integrated over the bandpass, the results show an improvement of 7.81 dB for this example. This procedure was repeated for all receiver channels and for 4, 8, 12, and 16 tap filter designs. The residual errors obtained are shown in Figure 5-6. (Note that the results for 16 taps show a characteristic flatness around 63 dB. This is due to the signal-to-noise limit of the input data. Actual improvements for 16 taps are probably in excess of this limit.

If the data of Figure 5-6 are averaged over all receivers, the results may be plotted as a design parameter curve showing residual error versus filter length. This is done in Figure 5-7.

Finally, Appendix G shows all of the results with designed filters for all receivers and channels and for 4, 8, 12, and 16 taps.

5.2 Alternative Uses of the Transversal Filter

In considering the utility of a digital transversal filter for equalization, the possibility of its application for other purposes comes to mind. Three areas where this may offer specific gains are given here as examples.

5.2.1 Response Synthesis

The filter may be used to synthesize some desired overall frequency response. This could include

- Removal of in-band ripple caused by the analog filter response
- Steepen the roll-off characteristics of the receiver bandpass
- Tailor the receiver bandpass to approximate a Gaussian response to prevent ringing.

5.2.2 Adaptivity

The filter may service directly in a signal processor that adaptively sets the filter weights (e.g., a Griffith's algorithm).

5.2.3 Deterministic Range Patterns

The filter may be used to vary the antenna beam pattern with range in a frequency compression system in some desired deterministic fashion.
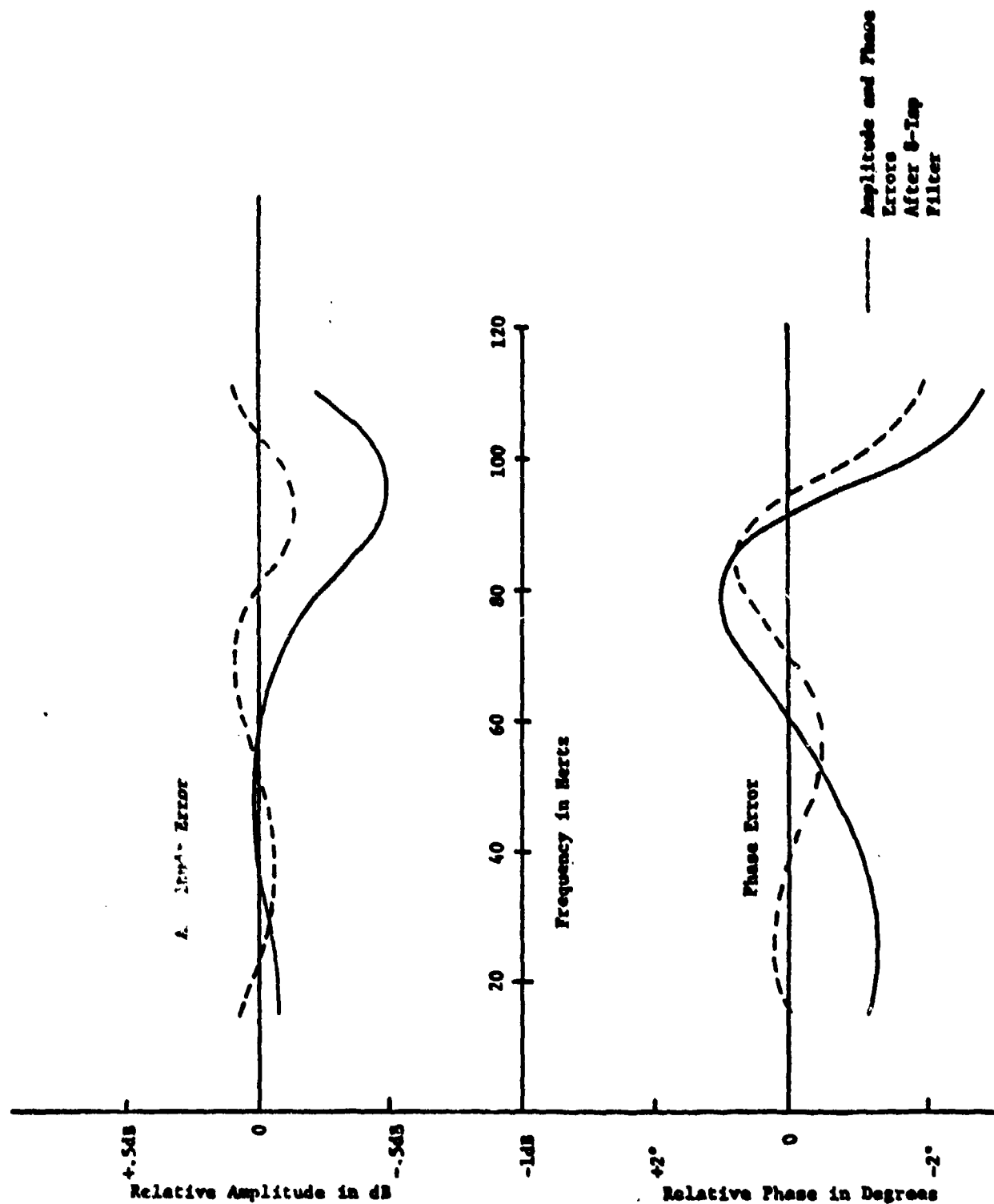
Figure 5-5. Amplitude and Phase Errors versus Frequency for Receiver #1, I-Channel and Receiver #2, I-Channel
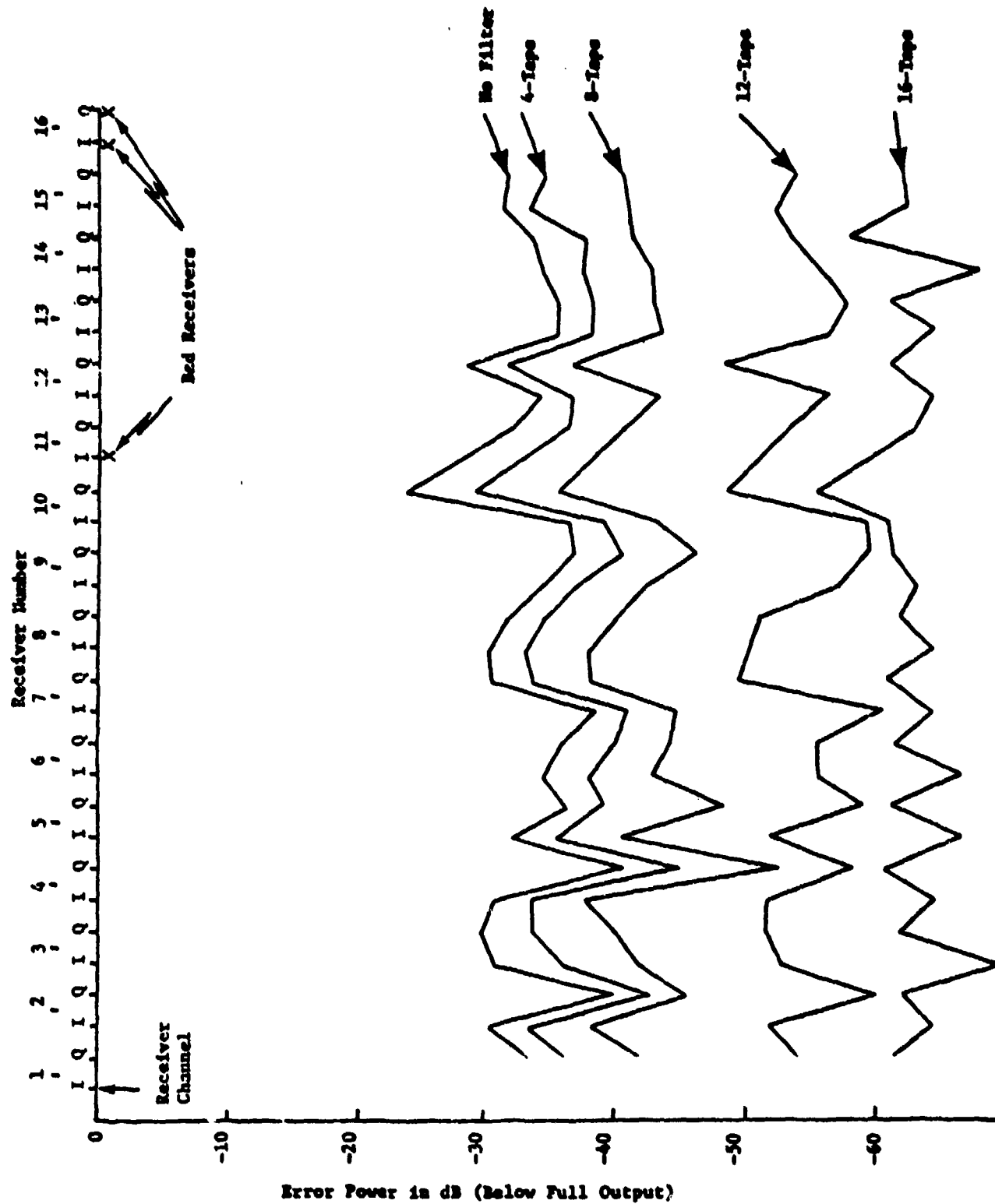
Figure 5-6.   Error Power versus Receiver Channel
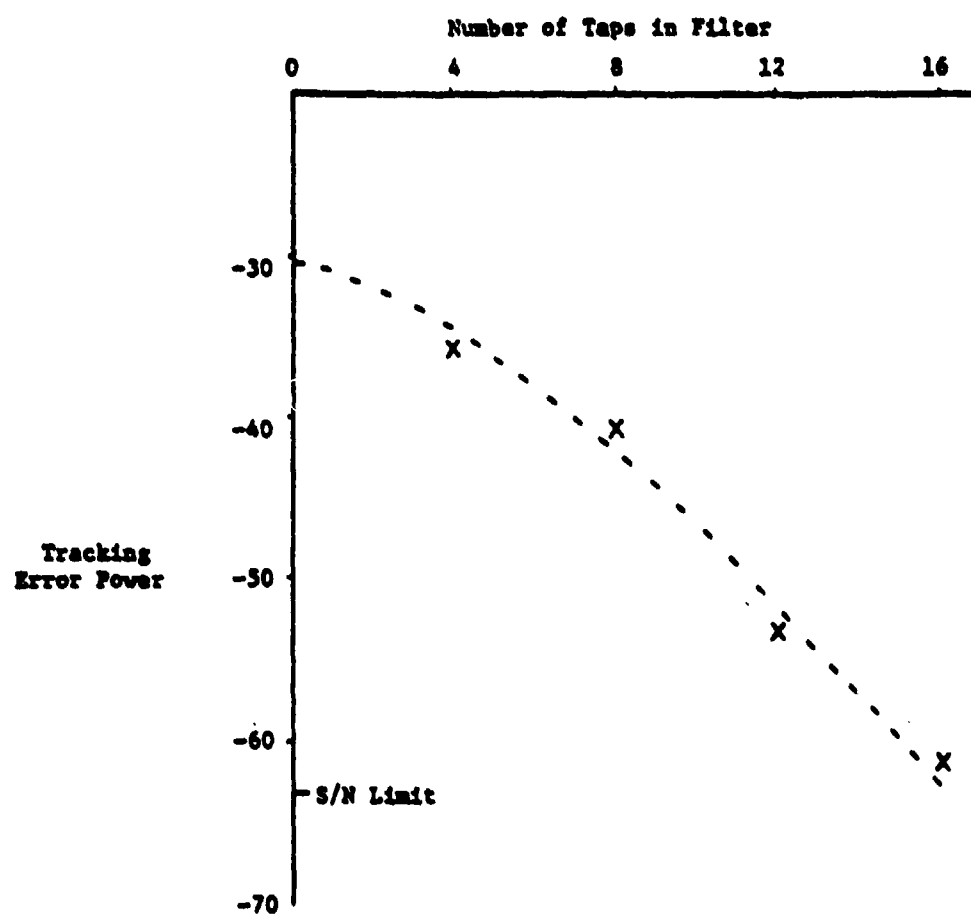
Figure 5-7. Residual Error Power versus Equalization Filter Length

6.0 RECOMMENDATIONS

The specific recommendations for work that remains to be done in the area of receiver filter tracking are:

- Use SRI's system to confirm design parameters on more conventional radar receivers.
- Demonstrate tracking improvement through increased range and spatial sidelobe control on WARF or RADC system.
- Evaluate limitations, with respect to receiver tracking, of PRS and determine impact on potential performance using adaptive technology.

7.0 RAYTHEON EFFORTS

Section 8.0 through 9.0 of this report describe the engineering services performed by Raytheon Company under subcontract to Technology Service Corporation in support of the RADC Adaptive Processing Program - Phase II. There were two primary tasks associated with this effort:

1. Adaptive Processing Software
2. Data Collection and Analysis Program

The first task was to upgrade the software package developed in the Phase I Program by adding a calibration procedure to use a near-field monopole source and by adding a Radar Processing mode. The Radar Processing Mode displays the Amplitude versus I.F. frequency for a fixed steer direction using either adaptive or conventional beamforming techniques. This mode is identified as the Radar mode because it processes the data in the manner in which an OTH radar operates. The addition of this mode will enable a determination of the capabilities of adaptive processing techniques to improve the performance of an OTH radar in the HF environment. The second task was to collect data using a 16-element array and Data Acquisition system at Dexter, New York, to: (1) provide data to checkout the software package; (2) to provide TSC with data which was required to develop and generate the equalization filters, and (3) to measure the performance of the 16-element array with OTH sources using conventional beamforming techniques.

Also included in the first task was the transfer of the off-line data processing programs developed under both Phase I and II to the Sigma-5 computer at RADC. This provides RADC with a complete in-house data processing capability. The transfer of these programs to the Sigma-5 has been successfully completed and we would like to thank the personnel at the Data Reduction Center at RADC for their cooperation in this task.

8.0 ADAPTIVE PROCESSING SOFTWARE

8.1 INTRODUCTION

Under the Phase I program, software was designed and implemented to process and display data collected on a temporary 16-element array at Dexter. This array was built especially for this program so that when the new 384-element planar array at Dexter was completed digital beamforming techniques developed in this program could be readily utilized on the new array. The software developed included a real-time operating system as well as an off-line data processing capability.

During the Phase II program, the off-line software was modified and augmented with additional capabilities. Before discussing the off-line software, the on-line system will be briefly described. Figure 8-1 shows a schematic block diagram of the on-line system. The output from each of the 32 receivers (I and Q receivers for each of the 16 elements) is digitized at a 250 samples/second rate. The digital data is recorded directly on 9 track/800 bpi tape in two's-complement binary format without processing. This is a very attractive feature as the data can be processed at a later date, using the off-line programs, with a variety of parameters and algorithms. The only limitation is the 200 Hz RF bandwidth and a sampling rate of 250 Hz for each receiver. In order to fully utilize this feature, calibration signals must be recorded during each data collection period. This allows a complete calibration to be implemented when the data is processed on the off-line system. During the data collection, a monitor channel is available which calibrates and displays the Angular Power Density Spectra, ADPS, for selected data.

The off-line processing software is schematically shown in Figure 8-2. The software has three major components:

1. Calibration: Uses either an internal test signal or a near-field monopole as a source to match phase and amplitude of the element ports receiver subsystems. Correction factors are generated and stored for later application to the data.
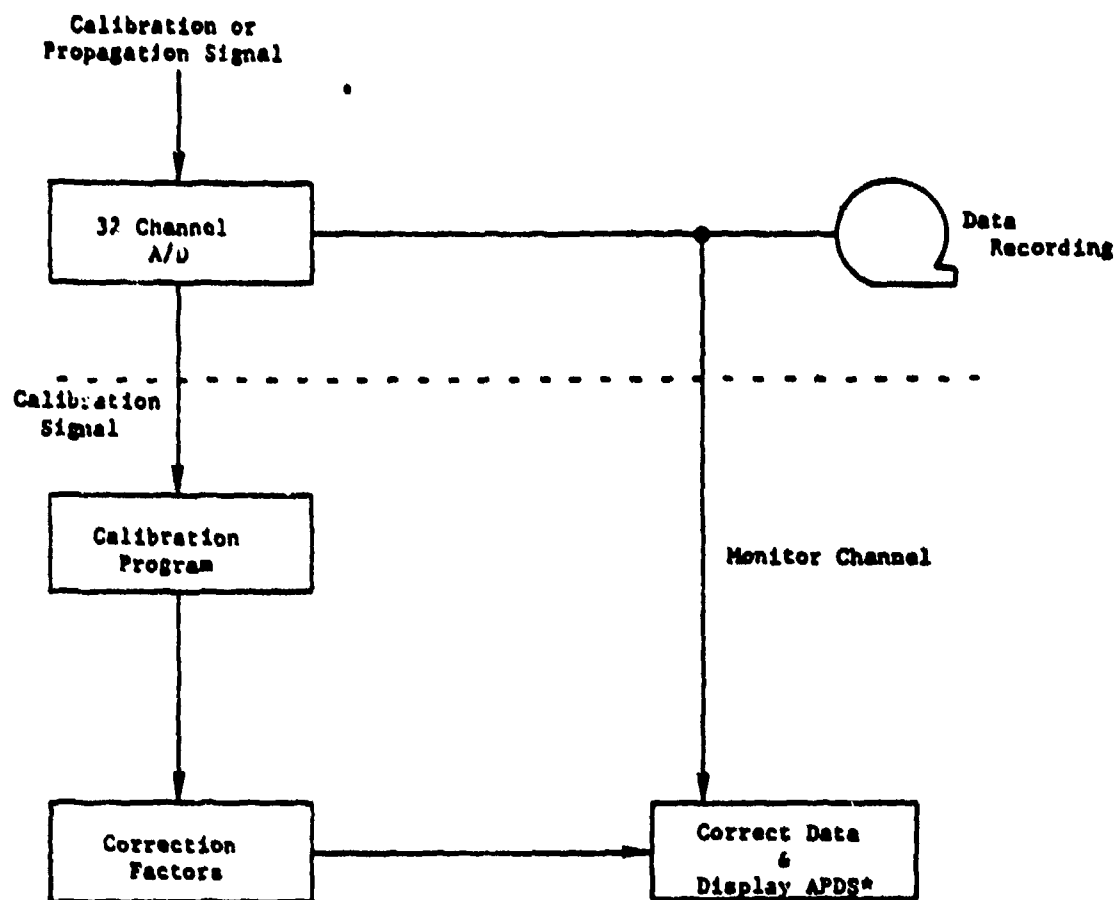
Figure 8-1. On-Line Data Recording System
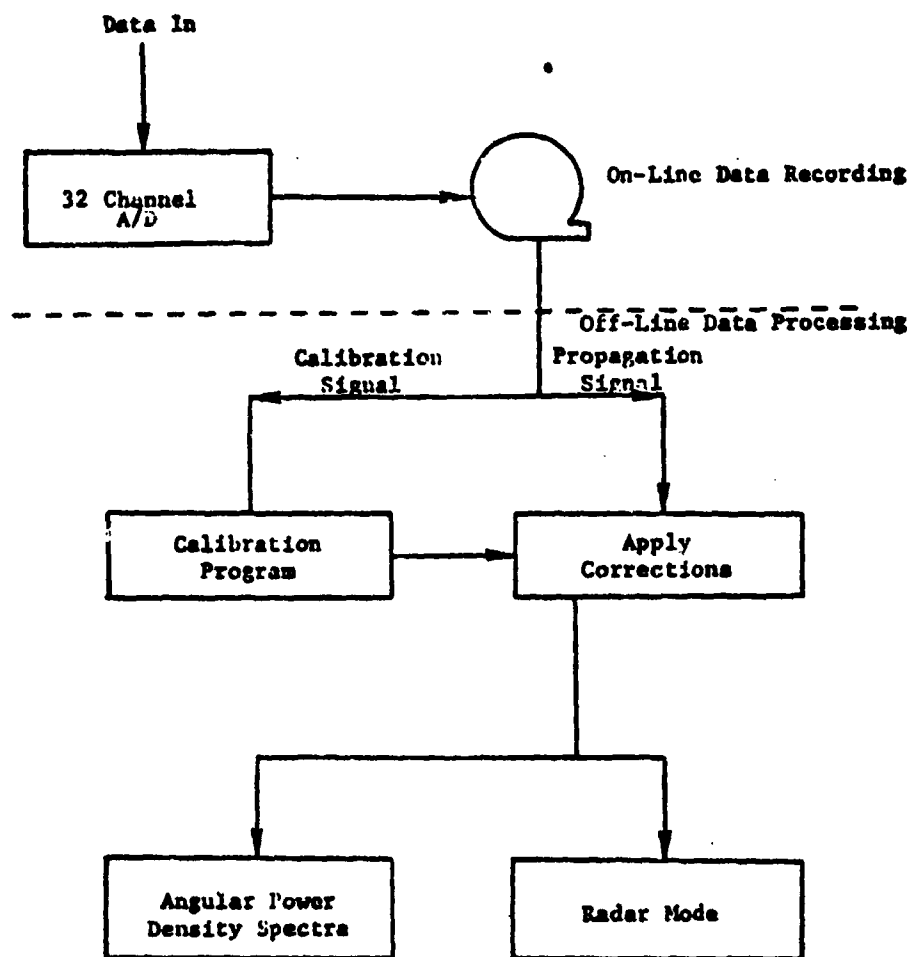
Figure 8-2.   Off-Line Data Processing

2. Angular Power Density Spectra (APDS): Generates the APDS using either adaptive or conventional (FFT) beamforming techniques.

3. Radar Mode: Generates amplitude versus frequency at fixed steer directions using either adaptive or conventional beamforming techniques.

Appendices A-E contain listings of the programs that comprise the off-line processing software. The programs and their nomenclature by which they are identified are listed in Table 8-1. These programs are currently operational on the Sigma-5 at RADC.

Table 8-1. Off-Line Adaptive Processing Software Programs

Appendix A: Calibration - MCALT

Appendix B: Conventional Angular Power
Density Spectra - CONVT

Appendix C: Adaptive Angular Power
Density Spectra -ADAPT

Appendix D: Radar Processing with Con-
ventional Techniques - RCONVT

Appendix E: Radar Processing with Adaptive
Techniques - RADAPT

8.2 Calibration (MCALT)

The 32 receivers in the Data Acquisition System were designed and measured to track within $\pm$ one percent in phase and $\pm$ one percent in amplitude with each other. Calibration procedures were implemented to remove systematic phase and amplitude errors introduced by the antenna and receiver subsystem, i.e., to maintain orthogonality between corresponding I and Q channels and amplitude and phase match between elements. Two calibration signals are available. One is an internal test signal which feeds an identical phase and amplitude reference signal into each of the 32 recei-vers. This will remove systematic errors in the receiver subsystem but not the antenna subsystem. A monopole located 600 m in front of the 16-element array can be used to calibrate the antenna subsystem as well as the receiver subsystem. The monopole, however, presents a spherical wave-front to the antenna and for it to provide a plane wave source, the cali-bration program was modified to remove the spherical nature of the signal wavefront from the reference monopole. Figure 8-3 is a block diagram of
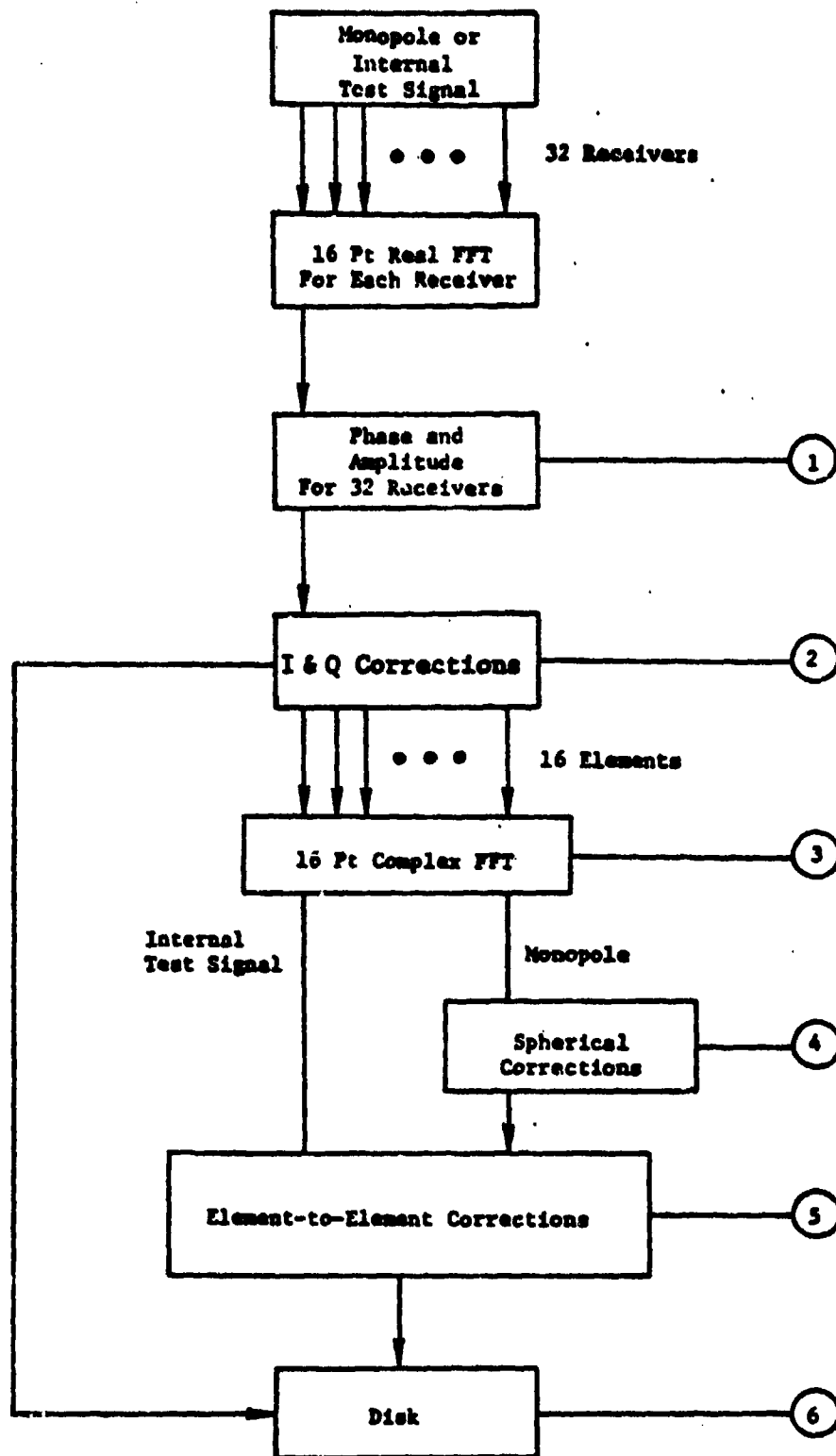
Figure 8-3. Calibration Procedures

the calibration procedure. The numbered points indicate where calibration data is displayed and hard copies available. The calibration program requires as input the time in hours, minutes, and seconds to specify the data on the tape to be used for calibration. In addition, the number of data sets (LTIMES) used in averaging the correction factors is specified. Each data set is 16 time samples or 0.064 s. The calibration source is also specified as Internal or Monopole. If the monopole source is used, the operating frequency in MHz of the monopole is also specified.

A 16 pt real FFT is performed to determine the phase and amplitude of the calibration tone for each of the 32 receivers. A single frequency tone is used for calibrating the receivers. This procedure matches the 32 receivers at only one point in the 100 Hz filter bandwidth. A digital equalization filter technique has been developed by TSC (Section 5.0 of this report) to correct for variations between receivers across the bandwidth of each filter. At this point, (1) and (2) in Figure 8-3, correction factors are generated which produce orthogonal and equal amplitude I and Q channels. The I channel of each receiver pair is left unchanged and the phase and amplitude of the Q channel is adjusted. The receivers are numbered 1 to 32 with the odd numbers being the I channels and the corresponding Q channel the next even number. A 16 pt complex FFT is applied to each port of the receive subsystem on the same data set used to obtain the I and Q corrections after the corrections are applied. This determines the phase and amplitude of each element of the array, (3) in Figure 8-3. Up to this point, there is no difference between the procedures for the monopole or internal test signal. The different procedure for each will be described separately below.

8.2.1 Internal Calibration Signal

The internal calibration signal is injected into the 32 receivers with equal phase and amplitude. This corresponds to a plane wave at boresight. For a plane wave at boresight, the response at all the elements must be of equal phase and amplitude. Defining the signal at each element as $S_n = A_n e^{i\phi_n}$ the correction factor for element n is $Z_n = \Delta A_n e^{i\Delta\phi_n}$ where $\Delta A_n = A_1/A_n$ and $\Delta\phi_n = \phi_1 - \phi_n$. Multiplying S_n by Z_n we get $A_1 e^{i\phi_1}$ for all n.

These correction factors, Z_n, insure that all the elements have the same phase and amplitude response for a plane wave at boresight; see (5) in Figure 8-3. The correction factors for each I-Q pair and element matching are stored on the disk. These corrections are then applied to data before the Angular Power Density Spectra or the radar maps are generated.

8.2.2 Monopole Calibration

A monopole was located in front of the 16-element array. Figure 8-4 shows the position of the monopole with respect to the 16-element array. The distances from the monopole to the front posts of the 1st and 16th element were surveyed.[*] A spherical wavefront from the monopole is also shown with the distance between the wavefront and each element shown in the Table. Before the systematic phase and amplitude corrections between elements can be determined, a factor has to be applied to the spherical wavefront to make it appear as a plane wave. A correction factor based on a spherical calibration signal would distort the measurement of a plane wave source.

The signal measured at the nth element is $A_n e^{i\phi}n$. In order to make the spherical wave look like a plane wave, the monopole signal is phase retarded at each element by $\delta\phi_n = 2\pi d_{ns}/\lambda$ where d_{ns} is the distance between the wave front and the nth element. The element-to-element correction factor for the monopole source is $Z_n = \Delta A_n e^{i\Delta\phi}n$ where $\Delta A_n = A_1/A_n$ and $\Delta\phi_n = \phi_1 - (\phi_n - \delta\phi_n)$. With this correction factor <u>both</u> the antenna and receiver subsystems are calibrated as in paragraph 8.2.1.

Figure 8-5 shows a conventional APDS for the OTH signal from WWV at 10 MHz using calibration factors obtained from the monopole with and without spherical corrections. Correcting for the spherical wavefront of the monopole signal improves the angular resolution of the conventional (FFT) APDS.

8.3 ANGULAR POWER DENSITY SPECTRA

The angular power density spectra (APDS) of the received energy is determined using either conventional or adaptive beamforming techniques. Figure 8-6 shows a block diagram of the APDS software for both the adaptive and conventional techniques.

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[*] The elements were 220 foot long single-wire Beverage elements with a spacing of 18.288 m. The element phase centers were chosen to be approximately 2/3 of the length of the element back from the front posts.

Calculated d_{n_s}, Meters	
El#	d_{n_s} Meters
1, 16	0.0
2, 15	4.033
3, 14	7.512
4, 13	10.427
5, 12	12.770
6, 11	14.534
7, 10	15.713
8, 9	16.303
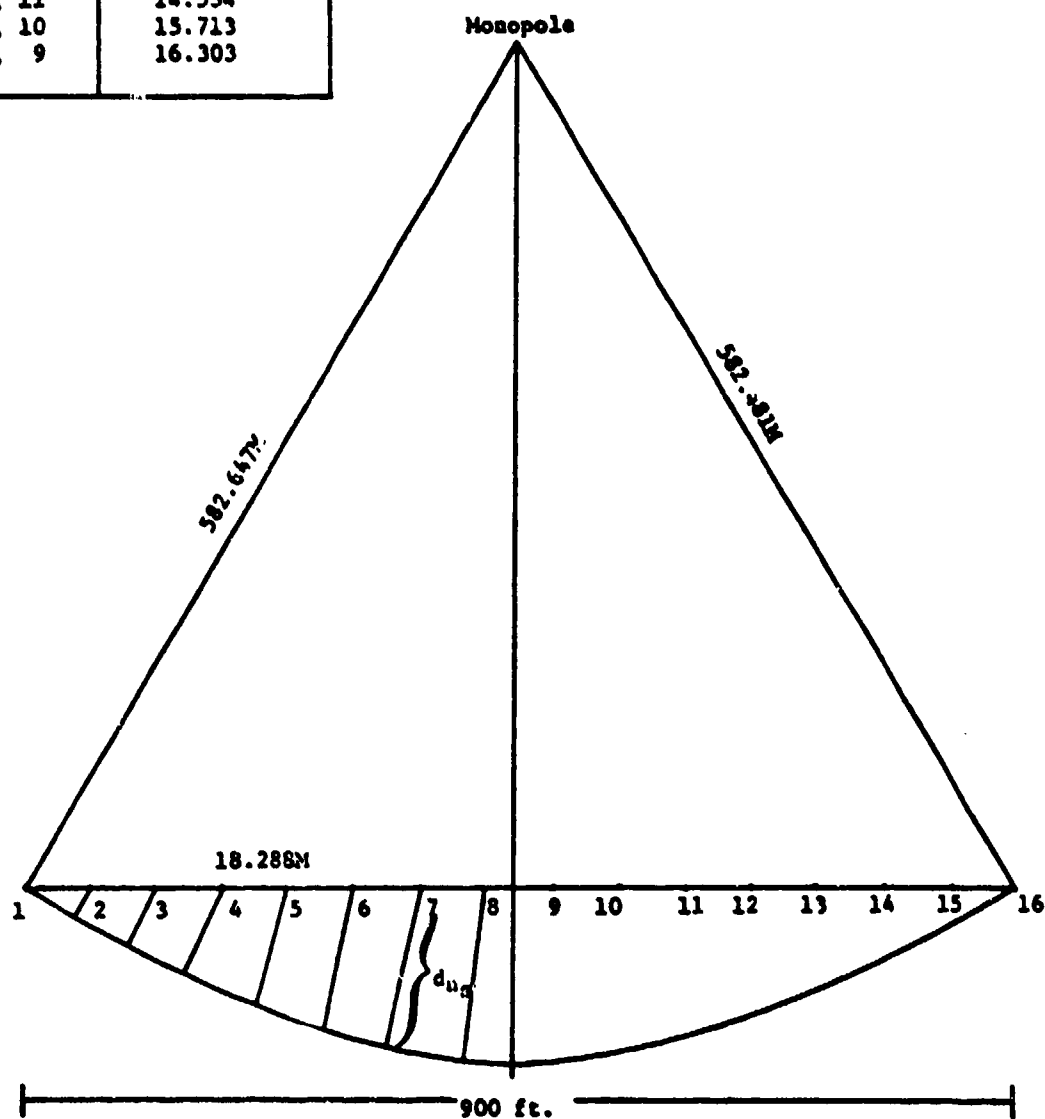
Figure 8-4. Location of Monopole with Respect to 16-Element Array
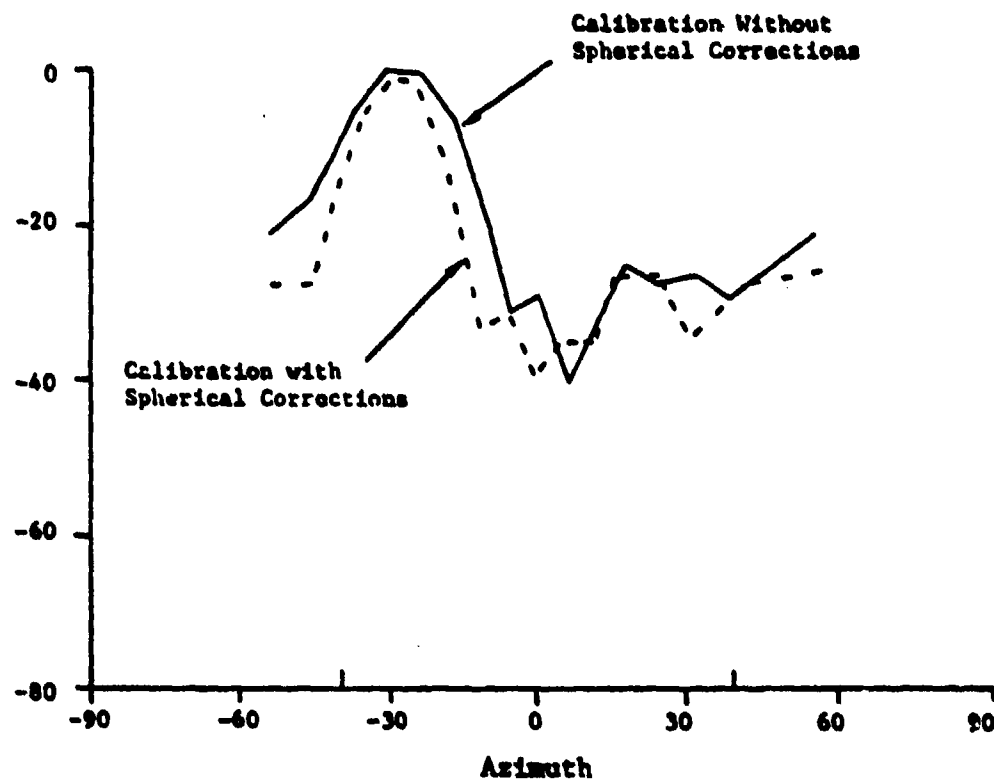
Figure 8-5. Conventional APDS of WWV Using Monopole Calibrations with and Without Spherical Corrections

Data Input

Apply
Corrections

Conventional   Adaptive

                                                        Mode 1
                                    Mode 2

70 dB D-C   70 dB D-C
&   &
Doppler FFT   Doppler FFT

70 dB D-C   Covariance
Spatial   Matrix &
Weight   Invert

Spatial FFT   Sequence
                                   Thru Set of
                                   Steer Vectors

APDS Display
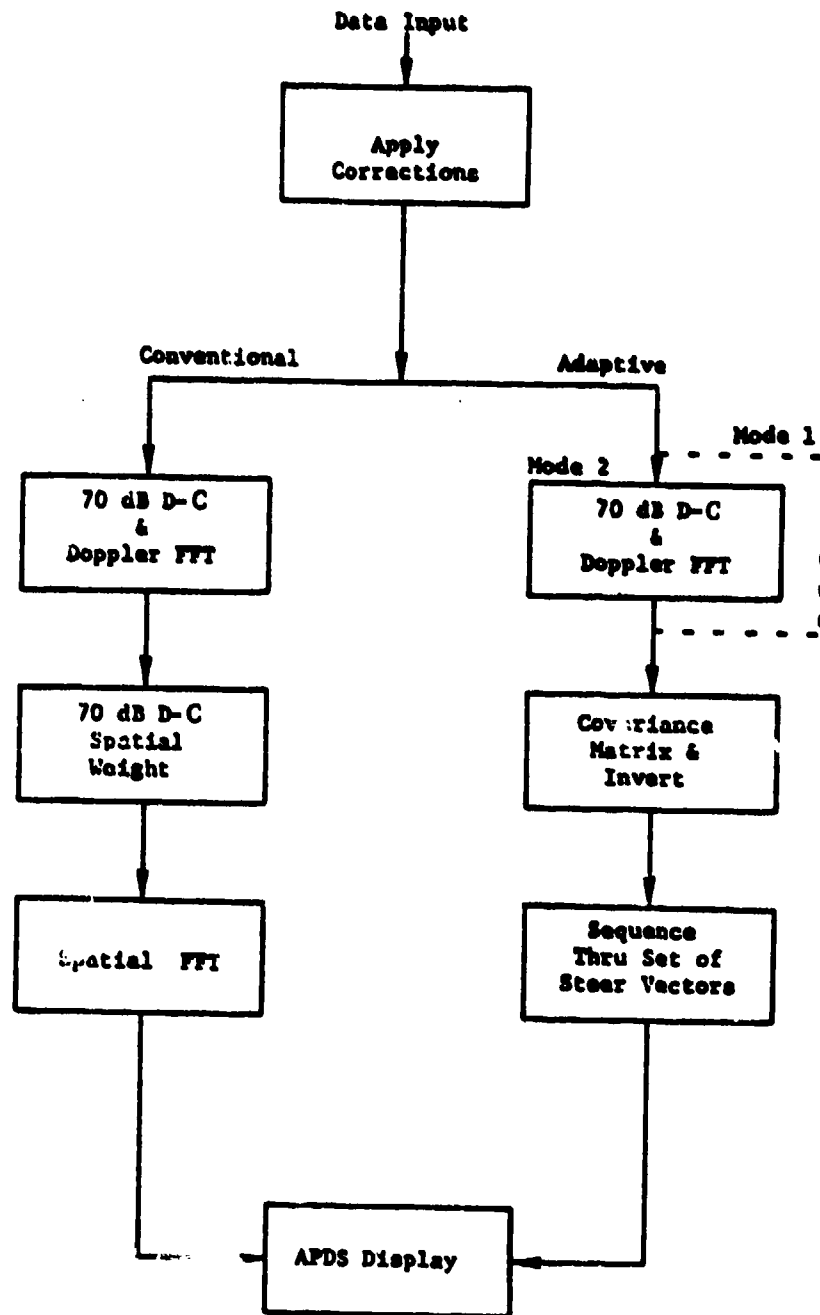
Figure 8-6.   Processing Required to Produce Conventional
              and Adaptive Angular Power Density Spectra

8.3.1 Conventional APDS (CONVT)

The conventional APDS is generated by the program CONVT. The input data is the time (hours, minutes, seconds) and the operating frequency. After the corrections are applied to the data, 16 time samples from each element are time-weighted with a 70 dB Dolph-Chebyshev (D-C) weighting function and a 16 pt complex FFT for each element is performed. This gives an effective 64 ms coherent integration period. For Element #1, the Doppler bin, where the peak signal occurs, is identified. The phase and amplitude for this Doppler bin is determined for the 16 elements. The 16 phase and amplitudes for this doppler bin are then spatially FFT'd using a 70 dB D-C weighting function. The 16 amplitude outputs from the spatial FFT form the APDS when plotted against the azimuths of the 16 FFT beam outputs.

Conventional (FFT) beamforming with a 16 pt spatial FFT provides 16 independent beam positions. The direction of the beams in sine (i.e. μ) space is defined by $\mu_n = \pm M/2 = n\lambda/Md$ where M is the number of elements, n is an integer from 0 to $\pm M/2$, and θ_n is the azimuth of the nth beam measured from boresight. The angle at which the FFT formed APDS will begin to repeat is when $n = \pm M/2$ or $\mu = \pm 1/2 \lambda/d$. For $\lambda = 2d$ this occurs at $\pm 90°$ in angle space, and for $\lambda < 2d$ the azimuthal angle coverage of the APDS is reduced. An FFT APDS beam position at the far right (n = M/2) is the same as the beam position on the far left of boresight. For successive values of $n = 0,1,2,...,M/2$, the beam positions are equally spaced in sine space up to the point where the FFT APDS begins to repeat. The same is true on the left of boresight. The output of the FFT APDS is 17-beam positions (two-beam positions are identical for n = M/2) equally spaced in sine space. Figure 8-5 shows the APDS for an OTH source (WWV) at 10 MHz. The source occurs at approximately 30° to the right of boresight. For APDS maps presented in this report, a negative beam position angle is to the right of boresight. The antenna boresight was 240°T and 30° to the right of boresight on the APDS corresponds to an azimuth of 270°T. The calculated direction to WWV from Dexter is 271.3°T. At 10 MHz and for an element spacing of 18.288 m the APDS covers azimuths $\pm 55°$ from boresight. The 17 data points at the output of the spatial FFT are formed within this $\pm 55°$ region. Also the points are equally spaced. Finally the maximum

steer $\theta_{s_{max}}$ for an array with no grating lobes in visible space is specified by the condition

$$\theta_{s_{max}} = \pm \sin^{-1} (\lambda/d - 1)$$

This maximum steer is indicated on the display by two vertical ticks on the horizontal axis which for a frequency of 10 MHz occur at $\pm 39.8°$.

8.3.2 Adaptive APDS (ADAPT)

The input parameters for the adaptive APDS program are time (hours, minutes, seconds), mode (1 = normal, 2 = spectral preprocessing of data), operating frequency, element configuration, and NGROUP. NGROUP is the number of sample groups used to generate the covariance matrix. Each sample group contains 16 complex time samples per array element. In the normal mode an NGROUP of 2 is usually selected. The normal mode indicates that the covariance matrix is determined for the entire filter bandwidth. In the preprocessing mode, a 16 pt complex FFT is performed on each element output and the peak signal is resolved in frequency. The covariance matrix is generated for a specific frequency cell in the filter bandwidth. (For a 16 pt FFT in mode 2, an NGROUP of 32 is required.

This report cannot discuss in detail the algorithms used in producing the adaptive APDS maps. A brief discussion will follow so that the computer programs in Appendix D can be followed. At a specified look direction the output of the beamformer is $y = W^*X$ where X is an N element complex column vector which represents the output of the N element array. W^* is the transpose conjugate of the weighting function for a specific look direction. For conventional beamforming $W^* = V^*$ where V is the unit vector in a specified steer direction. For adaptive beamforming it has been shown that the set of weights that optimize the SNR for a given look direction is:

$$W = \frac{F^{-1} V}{(V^* F^{-1} V)/M}$$

where F^{-1} is the inverse of the covariance matrix F, M is the number of elements, and $(V^* F^{-1} V)/M$ is a normalization factor. The power density in a given look direction is defined as yy^*. Using the definition of $y = W^* X$ we can show that:

$$yy^* = W^* XX^* W$$

$$= \frac{V^* F^{-1*} XX^* F^{-1} V}{\dfrac{(V^* F^{-1} V)}{M} \dfrac{(V^* F^{-1} V)}{M}}$$

Since $\quad XX^* \triangleq F, \quad F^* = F, \quad \text{and} \quad (F^{-1})^* = F^{-1}$

$$yy^* = V^* F^{-1} FF^{-1} V = M^2 \frac{V^* F^{-1} V}{(V^* F^{-1} V)^2}$$

$$\therefore \qquad yy^* = \frac{M^2}{V^* F^{-1} V}$$

This defines the power density for a given look direction. The APDS is obtained by calculating $1/(V^* F^{-1} V)$ for 65 look directions equally spaced in sine space from -1 to +1. The APDS for WWV at 10 MHz using Adaptive weights as generated by the adaptive algorithm described above is illustrated in Figure 8-7.

8.4 Radar Processing

An HF/OTH radar detects targets after range/Doppler processing. Evaluation of conventional and adaptive beamforming techniques for OTH radars requires processing of the data in a radar detection mode. For this reason, the off-line adaptive processing software has been augmented with a radar processing mode. This mode displays amplitude versus frequency for a fixed steer direction. The beamforming weights can be generated with either conventional weights or adaptively calculated. Figure 8-8 is a block diagram of the radar processing mode. The data is represented by an N element column vector X. The beamformer multiples this column vector by a weighting function row vector determined either adaptively or conventionally. The output of the beamformer is a time series of the complex scalar y. This time series is weighted and FFT'd. The output is the amplitude versus frequency for a selected azimuth. In the current program, the size of the FFT varies from 16 to 256 complex points which for a sample rate of 250 complex samples/second represents a coherent integration time which varies from 0.064 to 1.024 seconds.
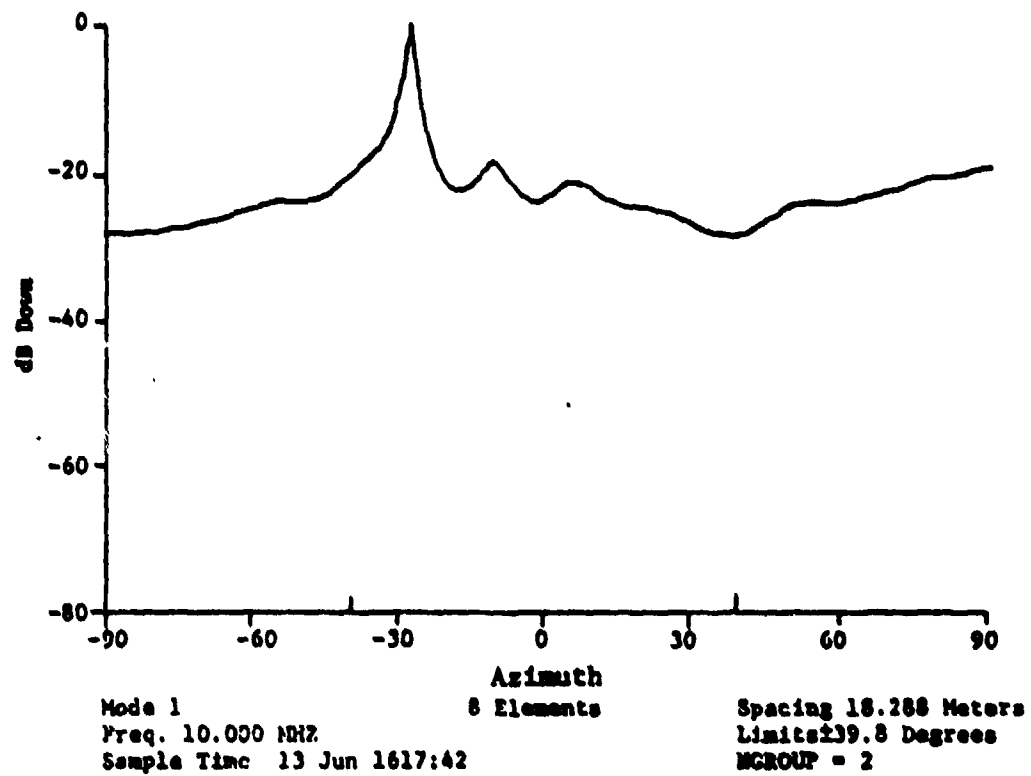
Figure 8-7.   Example of Angular Power Density
               Spectra Using Adaptive Weights
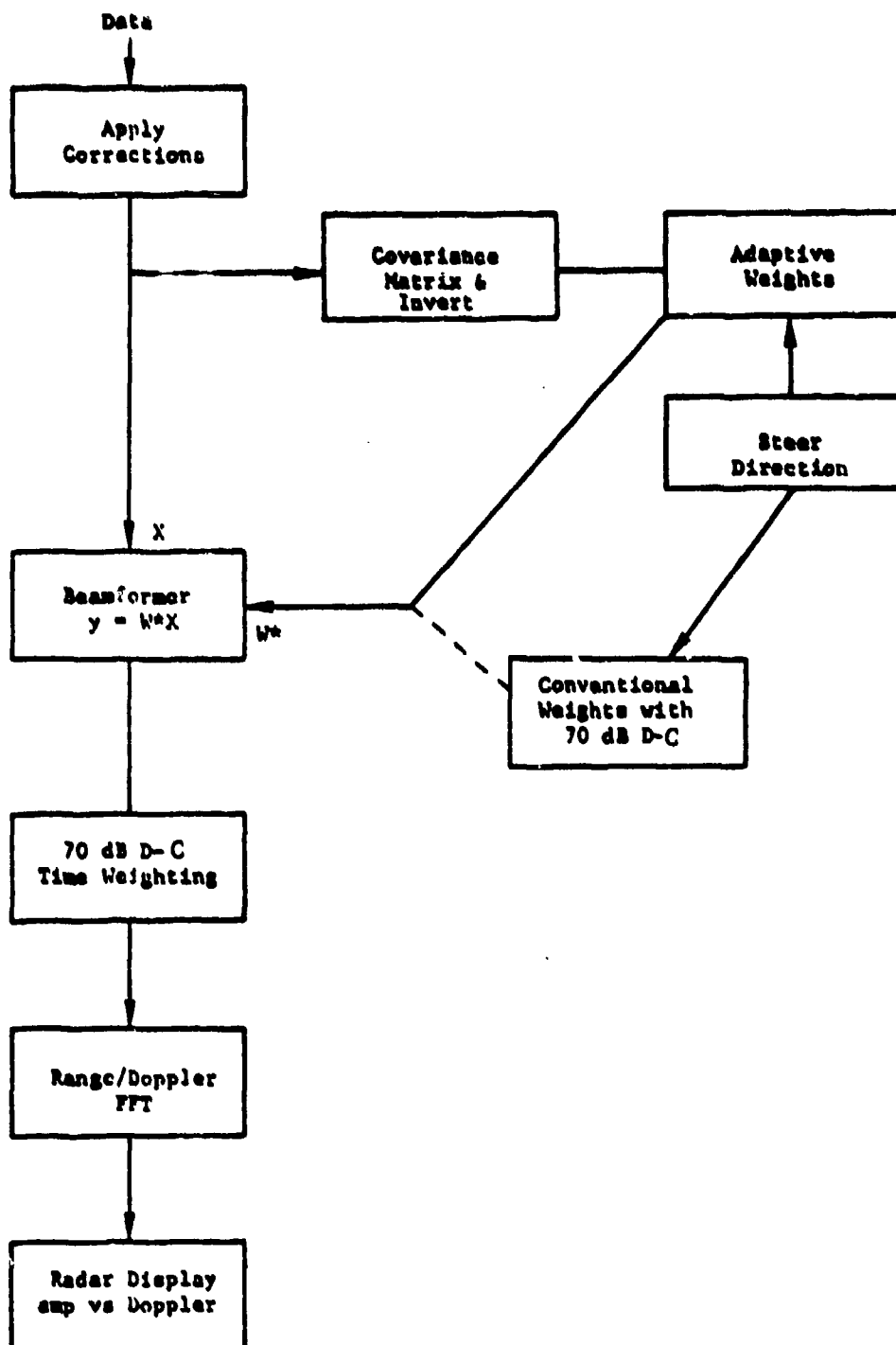
Figure 8-8. Block Diagram of Radar Processing for Adaptive and Conventional Beamforming

8.4.1 Conventional Beamforming (RCONVT)

The steer direction specified determines the steer vector V. For conventional beamforming W = V. In addition, a 70 dB D-C spatial weighting function is applied across the 16-element array. The program can easily be generalized to apply different spatial weightings if required. In addition, the number of elements can be variable and from 1 to N elements can be used. This is done by weighting with 0 those elements which are not desired. Depending on the desired frequency resolution, a time series of complex scalars, y, are obtained from the output of the beamformer. A 70 dB D-C time window, which is specified by the size of the FFT, is applied to the data. The amplitude output of the resultant FFT is displayed. Figure 8-9 shows the output of the radar mode with a 256 pt FFT for a 50 Hz test tone at boresight. The horizontal axis shows both the FFT cell number and its associated frequency cell in the 250 Hz band as determined by the sampling rate. In addition to the sample time and the steer direction (relative to boresight) the peak signal is shown. The data when plotted is scaled so that the peak signal occurs at 0 dB. The value of the peak signal can be used to compare signal levels at the same FFT cell for different steer directions. This assumes that the same data set is used to produce the radar maps at the selected steers.

Figure 8-10 shows the output of the radar processing mode at 0° and -27.95° for WWV signals at 10 MHz. The signal from WWV at the 0° steer is 39.1 dB below the signal at the -27.9° steer. The conventional APDS for this time period (see Figure 5) is in agreement as it shows a slightly less than 40 dB sidelobe level at 0° when compared to the peak of the APDS.

8.4.2 Adaptive Beamforming (RADAPT)

For the radar mode using adaptive weights, data is read in, stored onto the disk, and added to the covariance matrix, as in ADAPT. The matrix is then inverted and the weights in a given look direction are

$$W = F^{-1}V/((V*F^{-1}V)/M)$$

and the output of the beamformer is

$$y = W* X.$$

Sample Time 13 Jun 1614:30   Steer = .000,   Peak = 83.819 dB
Using Conventional Weights
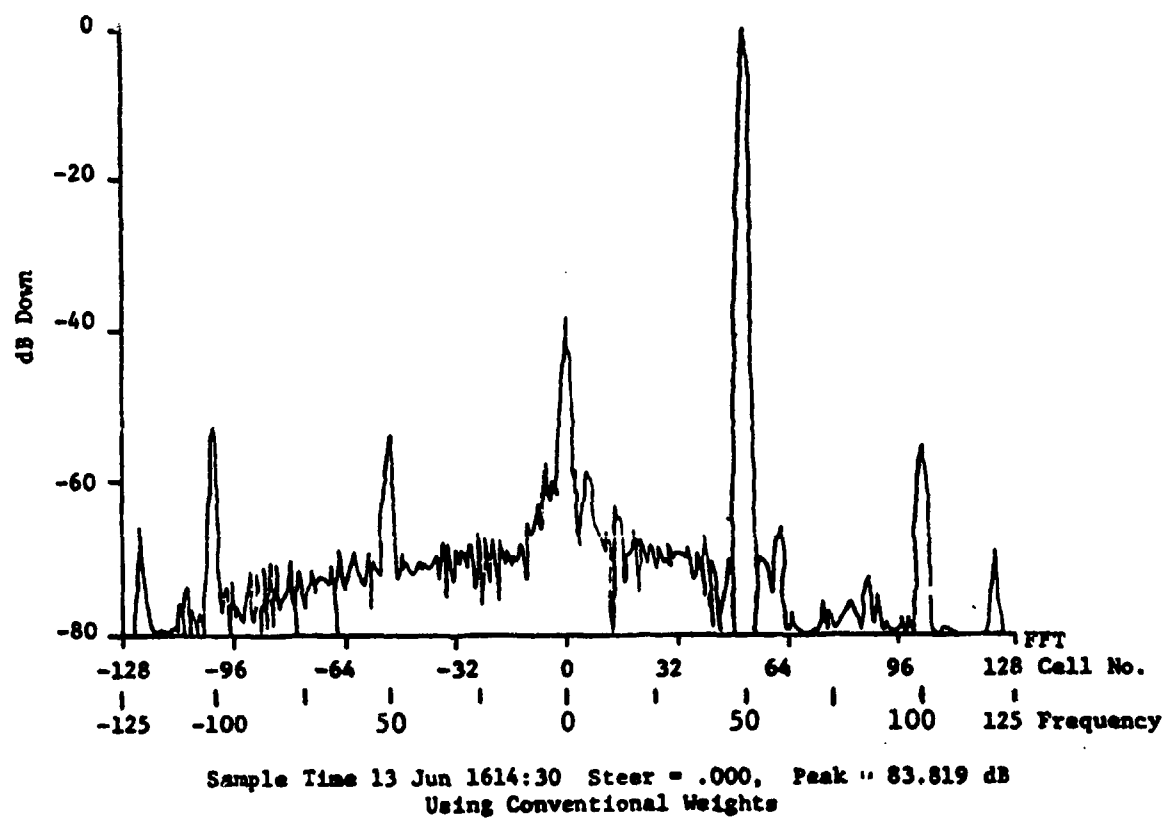
Figure 8-9.   Radar Map with Conventional Weights of
a 50 Hz Test Tone at Boresight
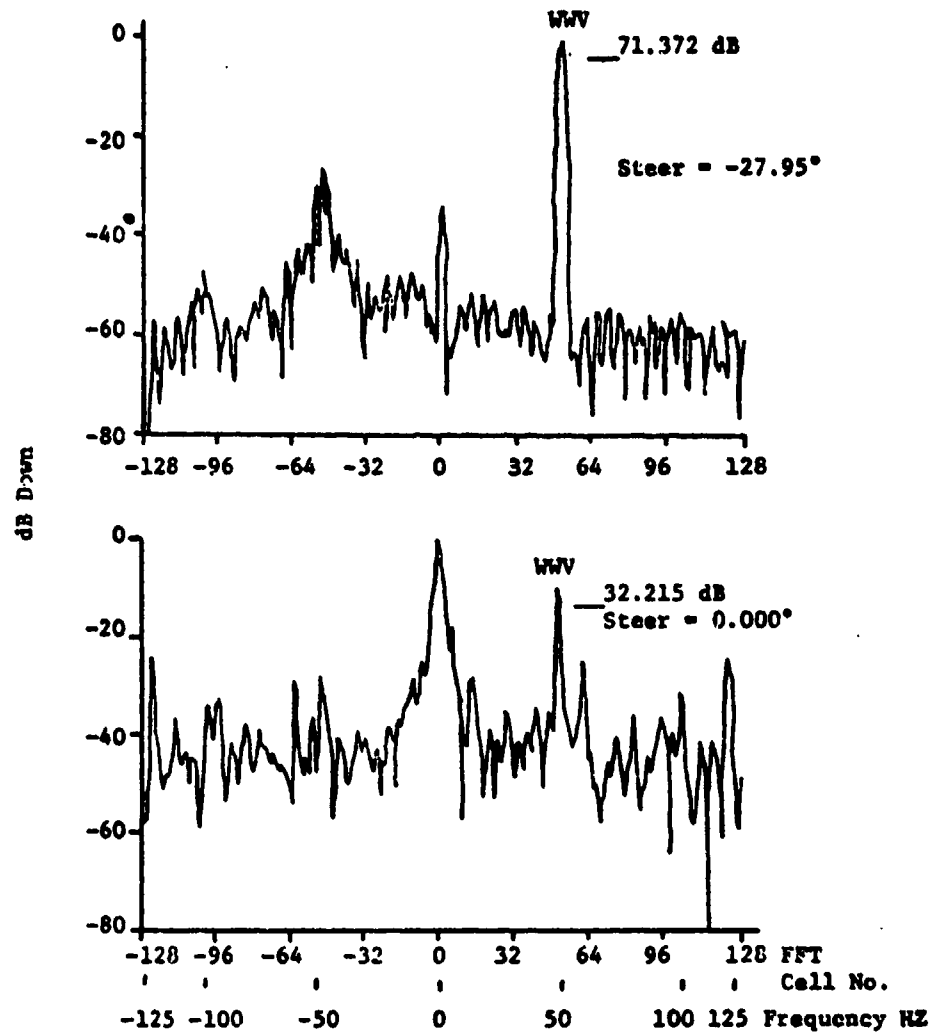
Figure 8-10. Conventional Radar Map of 10 MHz WWV Signal
at 0° and -27.95° Steer

As for the conventional mode, a time series of 'y' is obtained and time windowed with a 70 dB D-C weights prior to the FFT. The weights can be generated for any look direction by the appropriate selection of the steer vector. In order to expedite the generation of radar maps using adaptive weights, the inverse of the covariance matrix is determined for a set of data and may be used for several azimuths without regenerating the covariance matrix.

The number of samples used to generate the covariance matrix is specified by NGROUP. In the adaptive radar mode, the number of time samples used is the doppler/range FFT size. The NGROUP required is specified by 2^4 x NGROUP = FFT size. For example, a 256 point FFT requires an NGROUP of 16. The covariance matrix is a 16 x 16 matrix (for 16-element array) which is formed by the expectation value of $\overline{x_i x_j}$. x_1 is the complex signal at the ith element and i and j are running indices representing the 16 elements. For an NGROUP of 16, 256 values of x_i are used to determine the expectation value of $\overline{x_i x_j}$. This approach ensures that the weights generated from a given data set are used on the same data set to generate the adaptive radar mode. The approach described above although specified at a 16-element array can be generalized to any number of elements. Figure 8-11 shows an adaptive radar map of WWV at 10 MHz using adaptive weights for an 8-element array. Indicated on the figure is the element configuration utilized.
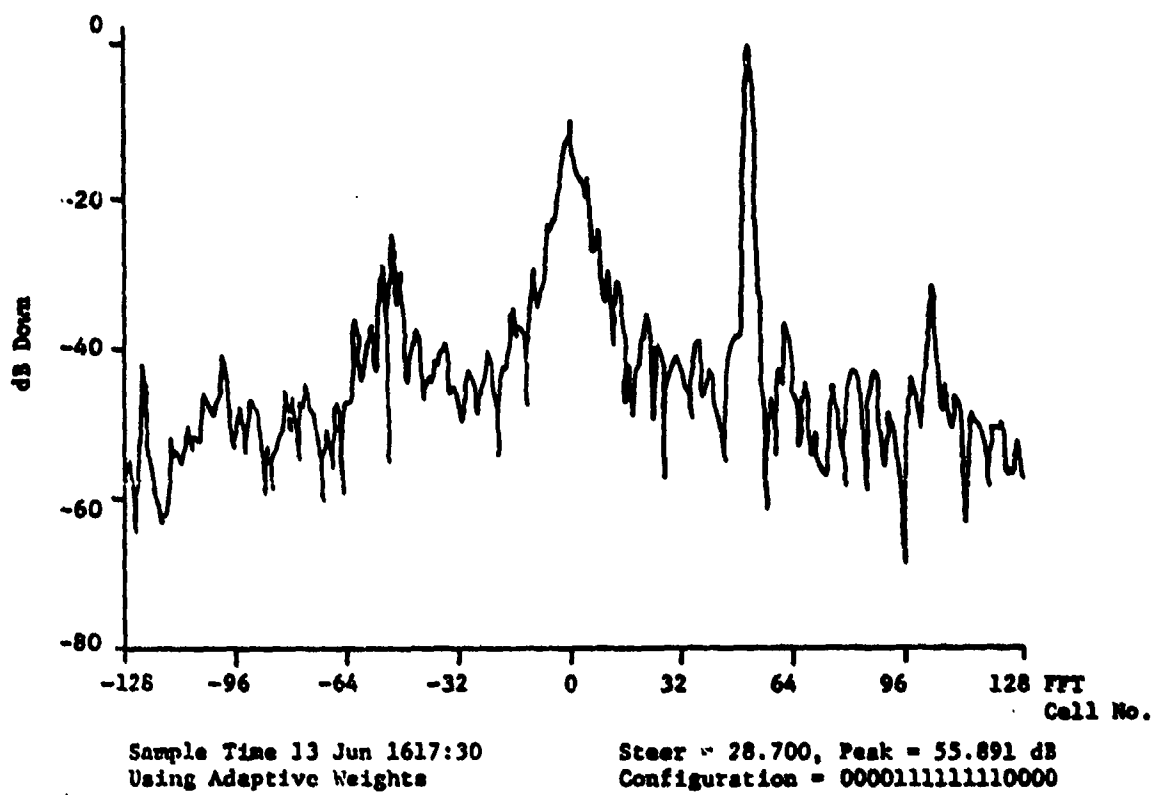
Figure 8-11. Adaptive Radar Map of a 10 MHz
WWV Signal at −28.7° Steer

9.0 EXPERIMENTAL PROGRAM

A limited experimental program was undertaken during this phase of the Adaptive Processing Program. The objective of the program was to:

1. Provide data necessary for implementation of Equalization Filter by TSC.

2. To provide data to check-out off-line adaptive processing software described in section two of this report.

3. To measure sidelobe levels with OTH sources achievable with the 16-element array using conventional beamforming.

Table 9-1 lists the data collected during the Phase II Adaptive Processing Program. The data for the equalization filter consisted of the output of the 32 receivers for CW Test Tones from 5 to 150 Hz in 5 Hz frequency increments. The data for each CW Test Tone was time weighted (with 70 dB D-C weighting) and processed with a 512 point reat FFT. The phase and amplitude of the test tone for each receiver was determined and referenced to Receiver 1. The results were forwarded to TSC for use in the construction of the digital equalization filter.

The WWV data was used to verify operation of the off-line software. This has been discussed in detail in Section 8.0 of this report. The data was also used to determine sidelobe levels achievable with the 16-element array for the OTH source. Figure 8-5 of this report illustrated a typical angular power density spectra of WWV which shows a 40 dB sidelobe response. Finally, two controlled CW sources (SRI and UI) were explored to determine performance of Adaptive and Conventional Processing in the presence of two sources. Unfortunately, transmitter difficulties at the University of Illinois prevented the observation of the two controlled CW sources.

Table 9-1. Data Collected During Phase II
Adatpive Processing Program

Date	Time	Comments
14 June 1975	1528:20 - 1544Z	Filter Equalization Data
14 June ···	1611:30 - 1634Z	WWV at 10 MHz
28 August 1975	2336:30 - 2355Z	WWV at 10 MHz
29 August 1975	0011 - 0027Z	SRI[1] & UI[2]: CW at 7.8 MHz
29 August 1975	0030:52 - 004:40Z	SRI & UI CW at 9:835 MHz
29 August 1975	0105:30 - 0121:15Z	SRI & UI: CW at 7:800 MHz
29 August 1975	0135:30 - 0149:30Z	SRI & UI: CW at 9:835 MHz

[1] SRI: Stanford Research Institute - CW Transmitter at
Los Lunas, New Mexico

[2] UI: University of Illinois - CW Transmitter in
Champagne, Illinois

LIST OF APPENDICES

A. Calibration Program

B. Conventional Angular Power Density Spectra

C. Adaptive Angular Power Density Spectra

D. Radar Processing with Conventional Beamforming

E. Radar Processing with Adaptive Beamforming

F. Equalization Filter Design Program

G. Equalization Filter Design Results

H. Adaptive Processing Wide Bandwidth Considerations

APPENDIX A

CALIBRATION PROGRAM

```
C      PROGRAM MCALT                                                      0000
C                                                                         0000
C                                                                         0000
C      THIS PROGRAM IS CALLED MCALT                                       0000
C      READS RAW CALIBRATION TONE SAMPLES FROM FIELD TAPE                 0000
C      AND GENERATES CORRECTION FACTORS.  SOURCE MAY EITHER               0000
C      BE INTERNAL OR EXTERNAL(MONOPOLE)                                  0000
C      READS TAPE  -  512 DATA WORDS + 11 PARAMETER WORDS = 523 WORDS.    0000
C                                                                         0000
C      9 SEPTEMBER 1975   1600    WITH CORRECTED MONOPOLE CORRECTIONS     0001
C                                                                         0001
       REAL ISAMPL,IQCORA,COS,CABS,CORA(16),ELPH(16)                      0001
       INTEGER CTIME,STIME,IDB(6)                                         0001
       COMPLEX ZCORR(16),ZSAMPL,ZCORR1,ZTEMP(16),ZZCORR(16),ZTEMP1,ZTEMP2 0001
C                                                                         0001
       DIMENSION IQCORA(16),DELPH(16),PHIOUT(16),YPOINT(16),OUTBUF(64),   0001
      *WBUF(523),DOLPH(16),XAM(16),XPH(16),IR(8),IV(6)                    0001
       DIMENSION DIST(8),SPHCOR(16)                                       0001
C                                                                         0001
       COMMON IBUF1(262),IBUF2(262),INBUF(523),ISAMPL(32),QSAMPL(32),     0002
      * AM(32),PH(32),CTIME(6),STIME(6)                                   0002
C                                                                         0002
       EQUIVALENCE(INBUF(1),WBUF(1))                                      0002
       EQUIVALENCE (OUTBUF(1),IQCORA(1)),(OUTBUF(17),DELPH(1)),           0002
      * (OUTBUF(33),ZCORR(1)),(PHIOUT(1),YPOINT(1))                       0002
C                                                                         0002
       DATA(DOLPH(I),I=1,16)/0.01266,0.05237,0.13904,0.28431,0.48131,     0002
      * 0.69921,0.889,1.0,1.0,0.889,0.69921,0.48131,0.28431,0.13904,      0002
      * 0.05237,0.01266/                                                  0002
       DATA (IR(I),I=1,8)/ZA0A0,ZA0A0,ZA0C3,ZCAC1,ZCECE,ZC5CC,ZA0CE,      0003
      * ZCFAE/                                                            0003
       DATA (IV(I),I=1,6)/ZA0A0,ZA0A0,ZA0A2,ZA0D6,ZCFCC,ZD4D3/            0003
       DATA (IDB(I),I=1,6)/ZA0A0,ZA0A0,ZA0C4,ZC2A0,ZC4CF,ZD7CE/           0003
       DATA (DIST(I),I=1,8)/0.0,4.033,7.512,10.427,                       0003
      1 12.770,14.534,15.713,16.303/                                      0003
       DATA IDUM,ICOLON,RAD,IFIRST,NSAMP,VCHAN/ZA0A0,ZBAA0,57.29578,      0003
      *0,512,32/                                                          0003
C                                                                         0003
       TAN(DUMMY)=SIN(DUMMY)/COS(DUMMY)                                   0003
C                                                                         0004
     1 CONTINUE                                                           0004
       DO 3 I=1,16                                                        0004
       CORA(I)=0.0                                                        0004
       ELPH(I)=0.0                                                        0004
     3 ZZCORR(I)=CMPLX(0.0,0.0)                                           0004
       CALL BURST                                                         0004
C                                                                         0004
C  LTIMES = NUMBER OF TIMES WANT TO AVERAGE THE CORRECTION FACTORS        0004
C                                                                         0004
       WRITE(13,111)                                                      0005
 111   FORMAT('TIME HR,MIN,SEC; LTIMES(3A2,I5)')                         0005
       READ(13,112) IHR,IMIN,ISEC,LTIMES                                  0005
 112   FORMAT(3A2,I5)                                                     0005
       WRITE(13,105)                                                      0005
 105 FORMAT('SOURCE?  0=INTERNAL  1=MONOPOLE (I1)')                       0005
       READ(13,106)ISOURC                                                 0005
 106 FORMAT(I1)                                                          0005
       IF(ISOURC.EQ.0)GO TO 1101                                          0005
C                                                                         0005
C  MONOPOLE TEST TONE SOURCE                                              0006
C  COMPUTE PHASE DISTANCES                                                0006
```

```
C                              57                              00062
      WRITE(13,107)                                            00063
  107 FORMAT('INPUT OPERATING FREQUENCY (F6.3)')               00064
      READ(13,108)FREQ                                         00065
  108 FORMAT(F6.3)                                             00066
      XLAMDA=299.7925/FREQ                                     00067
      DO 50 I=1,8                                              00068
      SPHCOR(I)=6.28318*DIST(I)/XLAMDA                         00069
   50 SPHCOR(17-I)=SPHCOR(I)                                   00070
 1101 IFILE=+1                                                 00071
      CALL RDTAPE(IFILE)                                       00072
      CALL TMASCI(CTIME)                                       00073
      IF(CTIME(4).NE.IHR.OR.CTIME(5).NE.IMIN.OR.CTIME(6).NE.   00074
     1    ISEC) GO TO 1101                                     00075
      DO 6800 LT=1,LTIMES                                      00076
C                                                              00077
C     OUTPUT LT COUNT ON THE RTR        SET RTR TO 71          00078
C                                                              00079
      CALL RTRDOT(LT)                                          00080
C                                                              00081
C     READ A RECORD                                            00082
C                                                              00083
      IF(LT.EQ.1) GO TO 1105                                   00084
      IFILE=+1                                                 00085
      CALL RDTAPE(IFILE)                                       00086
      CALL TMASCI(CTIME)                                       00087
 1105 DO 16 I=1,NSAMP                                          00088
   16 WBUF(I)=FLOAT(INBUF(I))                                  00089
C                                                              00090
C     PERFORM 16 PT. DFT ON EACH RECEIVER                      00091
C                                                              00092
      DO 6700 ICORR=1,2                                        00093
      DO 6699 IEL=1,16                                         00094
      ICONST=2*IEL-1                                           00095
      IF(ICORR.EQ.1)GO TO 4                                    00096
      ANGLR=(90.0-DELPH(IEL))/RAD                              00097
      COSANG=COS(ANGLR)                                        00098
      TANANG=TAN(ANGLR)                                        00099
    4 CONTINUE                                                 00100
      DO 69 I=1,16                                             00101
      IRXWD=ICONST+32*(I-1)                                    00102
      I2=2*I                                                   00103
      I2M=I2-1                                                 00104
      ISAMPL(I2M)=WBUF(IRXWD)                                  00105
      ISAMPL(I2)=0.0                                           00106
      QSAMPL(I2M)=WBUF(IRXWD+1)                                00107
      QSAMPL(I2)=0.0                                           00108
      IF(ICORR.EQ.1)GO TO 69                                   00109
      QSAMPL(I2M)=QSAMPL(I2M)*IQCORA(IEL)/COSANG-ISAMPL(I2M)*TANANG  00110
   69 CONTINUE                                                 00111
C                                                              00112
C     THE ISAMPL ARRAY NOW CONTAINS 16 SAMPLES (IMAGINARY PART SET = 0.0)  00113
C     FOR A DFT ON THE I-CHANNEL                               00114
C     SAME FOR THE QSAMPL ARRAY                                00115
C                                                              00116
C     WINDOW PRIOR TO FFT                                      00117
C                                                              00118
      DO 691 I=1,16                                            00119
      I2=2*I                                                   00120
      ZSAMPL=CMPLX(ISAMPL(I2-1),ISAMPL(I2))*CMPLX(DOLPH(I),0.0)  00121
      ISAMPL(I2-1)=REAL(ZSAMPL)                                00122
      ISAMPL(I2)=AIMAG(ZSAMPL)                                 00123
```

```
      ZSAMPL=CMPLX(QSAMPL(I2-1),QSAMPL(I2))*CMPLX(DDLPH(I),0.0)      00124
      QSAMPL(I2-1)=REAL(ZSAMPL)                                      00125
  691 QSAMPL(I2)=AIMAG(ZSAMPL)                                       00126
C                                                                    00127
C     NOW PERFORM A DFT ON THE I-CHANNEL, THEN THE Q-CHANNEL         00128
C                                                                    00129
      CALL FORT(4,-1,ISAMPL,IFERR)                                   00130
      CALL FORT(4,-1,QSAMPL,IFERR)                                   00131
C                                                                    00132
C     THE ISAMPL ARRAY NOW CONTAINS 16 COMPLEX (32 TOTAL)SPECTRAL VALUES 00133
C     FOR ONE I-CHANNEL RECEIVER                                     00134
C     SAME FOR THE QSAMPL ARRAY                                      00135
C     NOW GET SPECTRA - AMPLITUDE AND PHASE VS. FREQUENCY            00136
C                                                                    00137
      DO 66 JCHANL=1,2                                               00138
      DO 68 I=1,16                                                   00139
      I2=2*I-1                                                       00140
      IF(JCHANL.EQ.2)GO TO 681                                       00141
      CALL AMPHAS(ISAMPL(I2),ISAMPL(I2+1),XAM(I),XPH(I))             00142
      GO TO 68                                                       00143
  681 CALL AMPHAS(QSAMPL(I2),QSAMPL(I2+1),XAM(I),XPH(I))             00144
   68 CONTINUE                                                       00145
C                                                                    00146
C     FIND MAXIMUM AMPLITUDE - THIS IS THE CAL TONE                  00147
C     SKIP XAM(1) = D.C.       DO ONLY THE FIRST HALF NUMBER OF PTS  00148
C     DUE TO THIS BEING A REAL FFT                                   00149
C                                                                    00150
      NPTS=9                                                         00151
      KOUNT=2                                                        00152
      CALL FNDMAX(XAM,NPTS,KOUNT)                                    00153
      IF(JCHANL.EQ.2)GO TO 665                                       00154
      AM(ICONST)=XAM(KOUNT)/3276.7                                   00155
      PH(ICONST)=XPH(KOUNT)                                          00156
      GO TO 66                                                       00157
  665 AM(ICONST+1)=XAM(KOUNT)/3276.7                                 00158
      PH(ICONST+1)=XPH(KOUNT)                                        00159
   66 CONTINUE                                                       00160
 6699 CONTINUE                                                       00161
C                                                                    00162
C     AM ARRAY CONTAINS AMPLITUDE VALUES(VOLTS) FOR ALL RECEIVERS, 1-32 IN 00163
C     ORDER I(1), Q(1), I(2), Q(2) ... I(16), Q(16)                 00164
C     PH ARRAY CONTAINS PHASE VALUES(DEGREES) FOR ALL RECEIVERS IN THE 00165
C     SAME ORDER                                                     00166
C     NOW PLOT AMPLITUDES                                            00167
C                                                                    00168
  500 CALL SSWTCH(2,IUP)                                             00169
      IF(IUP.EQ.1)GO TO 500                                          00170
      CALL BURST                                                     00171
      WRITE(13,100)(CTIME(I),I=1,5),ICOLON,CTIME(6),LT               00172
  100 FORMAT(22X,'CORRECTION TIME  ',3A2,3X,2A2,A1,A2,11X,I3)        00173
      CALL TKWAIT                                                    00174
      CALL TKPLOT(0,0,0)                                             00175
      XSTART=3.6                                                     00176
      YSTART=3.3                                                     00177
      CALL AXIS(XSTART,YSTART,IR,-16,6.0,0.0,1.001,5.001)            00178
      CALL AXIS(XSTART,YSTART,IV,+12,2.0,90.0,0.001,1.001)           00179
      DO 70 I=1,32                                                   00180
      X=FLOAT(I-1)*0.2+XSTART                                        00181
      Y=AM(I)/1.0+YSTART                                             00182
      IF(I.GT.1)GO TO 699                                            00183
      CALL PLOT(X,Y,3)                                               00184
      GO TO 70                                                       00185
```

```
  899 CALL PLOT(X,Y,2)                                                     00186
   70 CONTINUE                                                             00187
                                                                          00188
C                                                                         00189
C   PRINT OUT PHASE VALUES - A I'S ABOVE A Q'S                            00190
C                                                                         00191
      DO 72 JPAIR=1,16                                                    00192
      J=2*JPAIR                                                           00193
      IF(ICORR.EQ.2)GO TO 719                                            00194
      IQCORA(JPAIR)=AM(J-1)/AM(J)                                         00195
      DELPH(JPAIR)=ABS(PH(J-1)-PH(J))                                     00196
      IF(DELPH(JPAIR).GE.180.)DELPH(JPAIR)=360.0-DELPH(JPAIR)             00197
      PHIOUT(JPAIR)=DELPH(JPAIR)                                          00198
      CORA(JPAIR)=CORA(JPAIR)+IQCORA(JPAIR)                               00199
      ELPH(JPAIR)=ELPH(JPAIR)+DELPH(JPAIR)                                00200
      GO TO 72                                                            00201
  719 PHIOUT(JPAIR)=ABS(PH(J-1)-PH(J))                                    00202
      IF(PHIOUT(JPAIR).GE.180.)PHIOUT(JPAIR)=360.0-PHIOUT(JPAIR)          00203
   72 CONTINUE                                                            00204
      CALL PLOT(0.0,2.2,-1)                                               00205
      WRITE(13,101) (PH(I),I=1,16,2),(PH(I),I=2,16,2),(PHIOUT(I),I=1,8),  00206
     * (PH(I),I=17,32,2),(PH(I),I=18,32,2),(PHIOUT(I),I=9,16)             00207
  101 FORMAT(23X,21HRECEIVER PHASE ANGLES,2(//2X,2H I,8F8.1,/2X,2H Q,     00208
     * 8F8.1,/1X,3HDIF,8F8.1))                                           00209
 6700 CONTINUE                                                            00210
C                                                                         00211
C   FINISHED I-Q CORRECTIONS  NOW FIND ELEMENT-ELEMENT CORRECTIONS        00212
C                                                                         00213
C   DO A COMPLEX DFT ON EACH ELEMENT                                     00214
C                                                                         00215
      DO 6800 ICORR=1,2                                                   00216
      ZCORR1=ZCORR(1)                                                     00217
      DO 5000 IEL=1,16                                                    00218
      ANGLR=(90.-DELPH(IEL))/RAD                                          00219
      COSANG=COS(ANGLR)                                                   00220
      TANANG=TAN(ANGLR)                                                   00221
      IF(ICORR.NE.2)GO TO 5100                                           00222
      ZCORR(IEL)=ZCORR1/ZCORR(IEL)                                        00223
      ZZCORR(IEL)=ZZCORR(IEL)+ZCORR(IEL)                                  00224
 5100 ICONST=2*IEL-1                                                      00225
      DO 5100 I=1,16                                                      00226
      IRXWD=ICONST+32*(I-1)                                               00227
      I2=2*I                                                              00228
      I2M=I2-1                                                            00229
      ISAMPL(I2M)=WBUF(IRXWD)                                             00230
      ISAMPL(I2)=WBUF(IRXWD+1)*IQCORA(IEL)/COSANG-ISAMPL(I2M)*TANANG      00231
C                                                                         00232
C   WINDOW PRIOR TO FFT                                                  00233
C                                                                         00234
      ZSAMPL=CMPLX(ISAMPL(I2M),ISAMPL(I2))*CMPLX(DOLPH(I),0.0)            00235
      IF(ICORR.EQ.2)ZSAMPL=ZSAMPL*ZCORR(IEL)                             00236
      ISAMPL(I2M)=REAL(ZSAMPL)                                            00237
 5100 ISAMPL(I2)=AIMAG(ZSAMPL)                                            00238
      CALL FORT(4,-1,ISAMPL,IFERR)                                        00239
C                                                                         00240
C   GET AMP AND PHASE OF CAL TONE                                        00241
C                                                                         00242
      DO 5101 I=1,16                                                      00243
      I2=2*I-1                                                            00244
 5101 CALL AMPHAS(ISAMPL(I2),ISAMPL(I2+1),XAM(I),XPH(I))                  00245
      NPTS=16                                                             00246
      KOUNT=2                                                             00247
      CALL FNDMAX(XAM,NPTS,KOUNT)
```

```
      KOUNT2=2*KOUNT                                          00248
      ZTEMP(IEL)=CMPLX(ISAMPL(KOUNT2-1),ISAMPL(KOUNT2))       00249
      IF(ICORR.GT.1)GO TO 4999                                00250
      ZCORR(IEL)=ZTEMP(IEL)                                   00251
 4999 AM(IEL)=XAM(KOUNT)/3276.7                               00252
 5000 PH(IEL)=XPH(KOUNT)                                      00253
C                                                             00254
C     PRINT OUT 16 ELEMENT AMPLITUDES AND PHASES             00255
C                                                             00256
  501 CALL SSWTCH(2,IUP)                                      00257
      IF(IUP.EQ.1)GO TO 501                                   00258
      CALL PLTEPE                                             00259
      IF(ICORR.GT.1.OR.ISOURC.NE.1)GO TO 6799                00260
CJ                                                            00261
C     COMPUTE AND PLOT MONOPOLE CORRECTIONS                  00262
C                                                             00263
      DO 6798 I=1,16                                          00264
      PH(I)=PH(I)+SPHCOR(I)*RAD                               00265
      IF(PH(I).GT.360) PH(I)=PH(I)-360.                       00266
 6798 CONTINUE                                                00267
      CALL SPHCOM(ZCORR,SPHCOR)                               00268
 5002 CALL SSWTCH(2,IUP)                                      00269
      IF(IUP.EQ.1)GO TO 5002                                  00270
      CALL PLTEPE                                             00271
      CALL PLOT(3,0,2.6,-1)                                   00272
      WRITE(13,115)                                           00273
  115 FORMAT(/6X,'WITH MONOPOLE CORRECTIONS')                00274
 6799 CONTINUE                                                00275
 6800 CONTINUE                                                00276
C                                                             00277
C     NOW AVERAGE CORRECTION FACTORS OVER LTIMES AND          00278
C     SAVE LATEST CORRECTION FACTORS ON DISC                  00279
C                                                             00280
      FLTLT=LTIMES                                            00281
      DO 6812 I=1,16                                          00282
      IQCORA(I)=CORA(I)/FLTLT                                 00283
      DELPH(I)=FLPH(I)/FLTLT                                  00284
      ZTEMP1=REAL(ZZCORR(I))/FLTLT                            00285
      ZTEMP2=AIMAG(ZZCORR(I))/FLTLT                           00286
 6812 ZCORR(I)=CMPLX(ZTEMP1,ZTEMP2)                           00287
      ISECT=1                                                 00288
      CALL DSKOUT(OUTBUF,ISECT,64)                            00289
C                                                             00290
C     TASK COMPLETE  NOW CHECK SS2   IF UP,WAIT   IF DOWN COMPUTE  00291
C     A NEW SET OF CALIBRATION CORRECTION FACTORS             00292
C                                                             00293
  502 CALL SSWTCH(2,IUP)                                      00294
      IF(IUP.EQ.1)GO TO 502                                   00295
      CALL BURST                                              00296
      WRITE(13,6811)IQCORA,DELPH,ZCORR                        00297
 6811 FORMAT(///2(/1X,8F9.4),/2(/1X,8F9.3),//2(/1X,4(2F7.4,4X)))  00298
  503 CALL SSWTCH(2,IUP)                                      00299
      IF(IUP.EQ.1)GO TO 503                                   00300
      GO TO 1                                                 00301
C                                                             00302
SMCALT    EQU   F.MAIN    NAME THE PROGRAM MCALT              00303
S         NTRY  MCALT                                         00304
S         LIBR  MCALT                                         00305
      END                                                     00306
```

```
      SUBROUTINE SPHCOM(Z,SPHCOR)                              00308
S         LIBR  SPHCOM                                         00309
      COMPLEX Z(16)                                            00310
      REAL CABS,COS                                            00311
      DIMENSION SPHCOR(16)                                     00312
      COMMON IDUM(1847),DUM(96),PH(32),IDUM1(12)               00313
      DO 1 I=1,16                                              00314
      Q1=CABS(Z(I))                                            00315
      Q3=PH(I)/57.29578                                        00316
      Q4=Q1*COS(Q3)                                            00317
      Q5=Q1*SIN(Q3)                                            00318
    1 Z(I)=CMPLX(Q4,Q5)                                        00319
      RETURN                                                   00320
      END                                                      00321
```

```
      SUBROUTINE RDTAPE(IFILE)                                       00323
S         NTRY   RDTAPE                                              00324
S         LIBR   RDTAPE                                              00325
C                                                                    00326
C    TAPE READ ROUTINE FOR CORRECTION FACTORS GENERATION ONLY USING 00327
C    PROGRAM CALT                                                    00328
C                                                                    00329
      COMMON IBUF1(262),IBUF2(262),INBUF(523)                        00330
      DATA ICOLON/ZBAA0/                                             00331
    5 NWORDS=523                                                     00332
      IUNIT=9                                                        00333
      IEOF=0                                                         00334
   10 CALL INP7(INBUF,NWORDS,IUNIT,IFILE,NWR)                        00335
      IF(IFILE)1,2,3                                                 00336
C   PARITY ERROR ON TAPE                                             00337
    1 WRITE(3,100)NWR                                                00338
  100 FORMAT(/5X,'TAPE PARITY',I5,'WORDS READ')                      00339
      GO TO 10                                                       00340
C   END OF FILE CONDITION                                            00341
    3 WRITE(3,101)                                                   00342
  101 FORMAT(/5X,'TAPE EOF')                                         00343
      IEOF=IEOF+1                                                    00344
      IF(IEOF.GE.2)STOP                                             00345
      GO TO 10                                                       00346
C   NORMAL READ                                                      00347
    2 IF(NWR.EQ.10)GO TO 4                                           00348
      IF(NWR.NE.523)WRITE(3,102)NWR                                  00349
  102 FORMAT(//15X,23HRECORD LENGTH INCORRECT,I5,11H WORDS READ)     00350
      CALL TIMOVE(INBUF(513))                                        00351
      RETURN                                                         00352
    4 WRITE(13,104)(INBUF(I),I=1,6),ICOLON,INBUF(7)                  00353
  104 FORMAT(//2X,A2,3X,3A2,3X,2A2,A1,A2)                            00354
      IFILE=+1                                                       00355
      GO TO 5                                                        00356
      END                                                            00357
```

```
      SUBROUTINE RIBDOT(K)                                        00359
S        NTRY   RIBDOT                                            00360
S        LIBR   RIBDOT                                            00361
      I=K                                                         00362
1111 CONTINUE                                                     00363
S        D      R.MACH,0                                          00364
S        LDW    I             FETCH NUMBER OF TIMES THRU LOOP     00365
S        DOT    7,1                                               00366
S        SMB    R.EXEC                                            00367
S        JSX    R.EXEC                                            00368
      RETURN                                                      00369
      END                                                         00370
```

```
      SUBROUTINE PLTE2E                                                    00372
S         NTRY  PLTE2E                                                     00373
S         LIBR  PLTE2E                                                     00374
C                                                                         00375
C                                                                         00376
C    SUBROUTINE PLTE2E PLOTS AMPLITUDE AND PRINTS OUT PHASES AND          00377
C    DIFFERENCES FOR 16 ELEMENTS                                          00378
C                                                                         00379
      REAL PHIOUT(16),DIFRAD(16),DIFVLT(16),TOTERR(16)                    00380
      INTEGER CTIME,STIME,IV(6),IE(7)                                     00381
      COMMON IDUMMY(1111),AM(32),PH(32),CTIME(6),STIME(6)                 00382
      DATA RAD,ICOLON/57.29578,ZBAA0/                                     00383
      DATA (IV(I),I=1,6)/ZA0A0,ZA0A0,ZA0A0,ZA0D6,ZCFCC,ZD4D3/            00384
      DATA (IE(I),I=1,7)/ZA0A0,ZA0C5,ZCCC5,ZCDC5,ZCED4,ZA0CE,ZCFAE/      00385
      CALL BURST                                                          00386
      WRITE(13,100)(CTIME(I),I=1,5),ICOLON,CTIME(6)                       00387
  100 FORMAT(22X,'CORRECTION TIME   ',3A2,3X,2A2,A1,A2)                   00388
      CALL TKWAIT                                                         00389
      CALL TKPLOT(0,0,0)                                                  00390
      XSTART=2.                                                           00391
      YSTART=3.3                                                          00392
      CALL AXIS(XSTART,YSTART,IE,-14,3.0,0.0,1.0,5.0)                     00393
      CALL AXIS(XSTART,YSTART,IV,+12,2.0,90.0,0.001,1.0)                  00394
      DO 5002 I=1,16                                                      00395
      X=FLOAT(I-1)*0.2+XSTART                                             00396
      Y=AM(I)/1.0+YSTART                                                  00397
      IF(I.GT.1)GO TO 5001                                               00398
      CALL PLOT(X,Y,3)                                                    00399
      GO TO 5002                                                          00400
 5001 CALL PLOT(X,Y,2)                                                    00401
 5002 CONTINUE                                                            00402
      DO 5003 I=1,16                                                      00403
      PHIOUT(I)=PH(I)-PH(1)                                               00404
      IF(PHIOUT(I).LT.-180.0)PHIOUT(I)=PHIOUT(I)+180.0                    00405
      IF(PHIOUT(I).GT.180.0)PHIOUT(I)=PHIOUT(I)-180.0                     00406
      DIFRAD(I)=PHIOUT(I)/RAD                                             00407
      DIFVLT(I)=1.0-(AM(I)/AM(1))                                         00408
 5003 TOTERR(I)=SQRT(DIFRAD(I)**2+DIFVLT(I)**2)                           00409
      CALL PLOT(0.0,2.6,-1)                                               00410
      WRITE(13,1)AM(1),PH(1),(PH(I),I=1,8),(PHIOUT(I),I=1,8),             00411
     *(DIFRAD(I),I=1,8),(DIFVLT(I),I=1,8),(TOTERR(I),I=1,8),              00412
     *(PH(I),I=9,16),(PHIOUT(I),I=9,16),(DIFRAD(I),I=9,16),(DIFVLT(I),    00413
     *I=9,16),(TOTERR(I),I=9,16)                                          00414
    1 FORMAT(6X,'ELEMENT PHASE AND AMPLITUDES',5X,'ELEMENT 1  AMP',F7.2,  00415
     * /50X,3HPHS,F7.2,2(//1X,6HPHASE ,8F9.2,/3X,4HDIF ,8F8.4,/,7HERRPHS  00416
     * ,8F8.4,//7HERRVLT ,8F8.4,//7HTOTERR ,8F8.4))                       00417
      RETURN                                                              00418
      END                                                                 00419
```

```
      SUBROUTINE AMPHAS(X,Y,A,P)
S        NTRY   AMPHAS                                          00421
S        LIBR   AMPHAS                                          00422
      RAD=57.29578                                              00423
      A=SQRT(X*X+Y*Y)                                           00424
      P=0.0                                                     00425
      IF(Y.EQ.0.0)RETURN                                        00426
      IF(X.LT.0.0)GO TO 67                                      00427
      P=ATAN(Y/X)*RAD                                           00428
      IF(Y.LT.0.0)P=360.0+P                                     00429
      RETURN                                                    00430
   67 P=180.0+ATAN(Y/X)*RAD                                     00431
      RETURN                                                    00432
      END                                                       00433
                                                                00434
```

```
      SUBROUTINE FNDMAX(XAM,NPTS,KOUNT)              00436
S        NTRY  FNDMAX                                00437
S        LIBR  FNDMAX                                00438
      DIMENSION XAM(16)                              00439
      K=KOUNT+1                                      00440
      PMAX=XAM(KOUNT)                                00441
      DO 1 I=K,NPTS                                  00442
      IF(XAM(I).LT.PMAX)GO TO 1                      00443
      PMAX=XAM(I)                                    00444
      KOUNT=I                                        00445
    1 CONTINUE                                       00446
      RETURN                                         00447
                                                     00448
```

APPENDIX B
CONVENTIONAL ANGULAR POWER DENSITY SPECTRA

```
C       PROGRAM CONVT                                                    00001
C                                                                        00002
C                                                                        00003
C       THIS PROGRAM IS CALLED 'CONVT'                                   00004
C       RETRIEVES CORRECTION FACTORS FROM DISK (PREVIOUSLY GENERATED BY  00005
C       PROGRAM 'MCALT'), READS DATA AND APPLIES SAID CORRECTION         00006
C       FACTORS, COMPUTES AND PLOTS CONVENTIONAL MAPS ON THE TEKTRONIX   00007
C       CRT USING DATA COLLECTED ON THE                                  00008
C       16 ELEMENT ARRAY AT RADC,  DEXTER, NEW YORK.                     00009
C       READS TAPE INPUT ONLY                                            00010
C                                                                        00011
C       4 SEPTEMBER 1975 WITH KOUNT FIX AND SPC=18.288                   00012
C                                                                        00013
        REAL ISAMPL(32),IQCORA(16),DELPH(16),BUF(64),COSANG(16),         00014
     *  TANANG(16),XAM(16),XPH(16)                                       00015
        REAL COS,AM(16),PH(16),YPOINT(17)                                00016
        REAL XPOINT(17)                                                  00017
        INTEGER CTIME(6),WBUF(523),IAZ(6),IDR(6)                         00018
        INTEGER KNTST(16),KNTCNT(16)                                     00019
        COMPLEX ZCORR(16),ZTEMP(16),DOLPH(16),ZSAMPL                     00020
C                                                                        00021
        COMMON IBUF1(262),IBUF2(262),INBUF(523)                          00022
        EQUIVALENCE (INBUF(1),WBUF(1))                                   00023
C                                                                        00024
        EQUIVALENCE (BUF(1),IQCORA(1)),(BUF(17),DELPH(1)),               00025
     *  (BUF(33),ZCORR(1))                                               00026
C                                                                        00027
        DATA (DOLPH(I),I=1,16)/(0.01266,0.0),(0.05237,0.0),(0.13904,0.0),00028
     *  (0.28431,0.0),(0.48131,0.0),(0.69921,0.0),(0.889,0.0),(1.0,0.0), 00029
     *  (1.0,0.0),(0.889,0.0),(0.69921,0.0),(0.48131,0.0),(0.28431,0.0), 00030
     *  (0.13904,0.0),(0.05237,0.0),(0.01266,0.0)/                       00031
        DATA(IAZ(I),I=1,6)/Z0000,Z0000,ZC1D4,ZC9CD,ZD5D4,ZC8A0/          00032
        DATA(IDR(I),I=1,6)/Z0000,Z0000,Z00C4,ZC2A0,ZC4CF,Z07CF/          00033
        DATA PI,RAD,NSAMP,NCHAN,ICOLON/3.14159,57.29578,512,32,Z8AA0/    00034
        DATA IDUM/Z0A0A/                                                 00035
C                                                                        00036
        TAN(DUMMY)=SIN(DUMMY)/COS(DUMMY)                                 00037
                                                                         
        ARSIN(DUMMY)=ATAN(DUMMY/SQRT(1.0-DUMMY**2))                      00038
                                                                         
C                                                                        00039
C    RETRIEVE CORRECTION FACTORS FROM DISK                               00040
C    COMPUTE ELEMENTAL PHASE ANGLE CORRECTIONS                           00041
C                                                                        00042
        ISECT=1                                                          00043
        CALL DSKIN(BUF,ISECT,64)                                         00044
        DO 91 IEL=1,16                                                   00045
        ANGLR=(90.0-DELPH(IEL))/RAD                                      00046
        COSANG(IEL)=COS(ANGLR)                                           00047
   91   TANANG(IEL)=TAN(ANGLR)                                           00048
C                                                                        00049
C    INPUT DESIRED TIME AND SEARCH TAPE FOR IT                          00050
C                                                                        00051
    1   CALL BURST                                                       00052
        WRITE(13,100)                                                    00053
  100   FORMAT('INPUT DESIRED TIME--HR,MIN,SEC;  FREQ (3A2,F7.3)')       00054
        READ(13,101) IHR,IMIN,ISEC,FREQ                                  00055
  101   FORMAT(3A2,F7.3)                                                 00056
        UMAX=300./(FREQ*2.*18.288)                                       00057
        WRITE(13,20057)                                                  00058
 20057  FORMAT('  SPACING=18.288 M')                                     00059
```

```
                                                                      00061
      IF(XU.LT.0.) XU=0.                                              00062
      IF(XU.GT.1.) XU=1.                                              00063
      XANGL=ARSIN(XU)*RAD                                             00064
      XUL=3.5-XANGL/30.                                               00065
      XUR=3.5+XANGL/30.                                               00066
      XPOINT(9)=3.5                                                   00067
      DO 1010 IP=1,8                                                  00068
      UTHET=FLOAT(IP)*UMAX/8.                                         00069
      THIN=3.                                                         00070
      IF(UTHET.LT.1.) THIN=RAD*ARSIN(UTHET)/30.                       00071
      XPOINT(IP+9)=3.5+THIN                                           00072
      IPP=9-IP                                                        00073
      XPOINT(IPP)=3.5-THIN                                            00074
1010  CONTINUE                                                        00075
   10 IFILE=+1                                                        00076
   11 CALL RDTAPE(IFILE)                                              00077
      CALL TMASCI(CTIME)                                              00078
      IF(CTIME(4).NE.IHR.OR.CTIME(5).NE.IMIN.OR.                      00079
     1  CTIME(6).NE.ISEC)    GO TO 10                                 00080
      GO TO 15                                                        00081
    2 IFILE=+1                                                        00082
      CALL RDTAPE(IFILE)                                              00083
      CALL TMASCI(CTIME)                                              00084
   15 DO 16 I=1,NSAMP                                                 00085
   16 WBUF(I)=FLOAT(INBUF(I))                                         00086
C                                                                     00087
C     APPLY ALL CORRECTION FACTORS TO NEW SAMPLES, ADD WEIGHTS AND    00088
C     DO A COMPLEX FFT                                                00089
C     WINDOW PRIOR TO FFT                                             00090
C                                                                     00091
      DO 5995 I=1,16                                                  00092
5995  KNTCNT(I)=0                                                     00093
      DO 6000 IEL=1,16                                                00094
      ANGLR=(90.0-DELPH(IEL))/RAD                                     00095
      COSANG=COS(ANGLR)                                               00096
      TANANG=TAN(ANGLR)                                               00097
      ICONST=2*IEL-1                                                  00098
      DO 6001 I=1,16                                                  00099
      IRXWD=ICONST+32*(I-1)                                           00100
      I2=2*I                                                          00101
      I2M=I2-1                                                        00102
      ISAMPL(I2M)=WBUF(IRXWD)                                         00103
      ISAMPL(I2)=WBUF(IRXWD+1)*TQCORA(IEL)/COSANG-ISAMPL(I2M)*TANANG  00104
      ZSAMPL=CMPLX(ISAMPL(I2M),ISAMPL(I2))*ZCORR(IEL)*DOLPH(I)        00105
      ISAMPL(I2M)=REAL(ZSAMPL)                                        00106
6001  ISAMPL(I2)=AIMAG(ZSAMPL)                                        00107
      CALL FORT(4,-1,ISAMPL,IFERR)                                    00108
      DO 40 I=1,16                                                    00109
      I2=2*I-1                                                        00110
   40 CALL AMPHAS(ISAMPL(I2),ISAMPL(I2+1),XAM(I),XPH(I))              00111
      NPTS=16                                                         00112
      KOUNT=0                                                         00113
      CALL FNDMAX(XAM,NPTS,KOUNT)                                     00114
      KOUNT2=2*KOUNT                                                  00115
      KNTCNT(KOUNT)=KNTCNT(KOUNT)+1                                   00116
      KNTST(IEL)=KOUNT                                                00117
6000  ZTEMP(IEL)=CMPLX(ISAMPL(KOUNT2-1),ISAMPL(KOUNT2))              00118
      KMAX=2                                                          00119
      DO 6003 I=3,16                                                  00120
      IF(KNTCNT(I).LT.KNTCNT(KMAX)) GO TO 6003                        00121
      KMAX=I                                                          00122
6003  CONTINUE
```

```
      KOUNT=KMAX                                                        00123
      KOUNT2=KOUNT*2                                                    00124
      DO 6005 IEL=1,16                                                  00125
      IF(KNTST(IEL).EQ.KOUNT) GO TO 6005                               00126
      ANGLR=(90.0-DELPH(IEL))/RAD                                       00127
      COSANG=COS(ANGLR)                                                 00128
      TANANG=TAN(ANGLR)                                                 00129
      ICONST=2*IEL-1                                                    00130
      DO 6201 I=1,16                                                    00131
      IRXWD=ICONST+32*(I-1)                                            00132
      I2=2*I                                                           00133
      I2M=I2-1                                                          00134
      ISAMPL(I2M)=WBUF(IRXWD)                                          00135
      ISAMPL(I2)=WBUF(IRXWD+1)*IQCORA(IEL)/COSANG-ISAMPL(I2M)*TANANG   00136
      ZSAMPL=CMPLX(ISAMPL(I2M),ISAMPL(I2))*ZCORR(IEL)*DOLPH(I)         00137
      ISAMPL(I2M)=REAL(ZSAMPL)                                         00138
 6201 ISAMPL(I2)=AIMAG(ZSAMPL)                                         00139
      CALL FORT(4,-1,ISAMPL,IFERR)                                     00140
      ZTEMP(IEL)=CMPLX(ISAMPL(KOUNT2-1),ISAMPL(KOUNT2))               00141
 6005 CONTINUE                                                         00142
C                                                                      00143
C     APPLY 70DB D-T WINDOW AND FFT ACROSS THE 16 ELEMENTS            00144
C                                                                      00145
      DO 31 I=1,16                                                     00146
      ZTEMP(I)=ZTEMP(I)*DOLPH(I)                                       00147
      I2=2*I                                                           00148
      ISAMPL(I2-1)=REAL(ZTEMP(I))                                      00149
   31 ISAMPL(I2)=AIMAG(ZTEMP(I))                                       00150
      CALL FORT(4,-1,ISAMPL,IFERR)                                     00151
      DO 32 I=1,16                                                     00152
      I2=2*I-1                                                         00153
   32 CALL AMPHAS(ISAMPL(I2),ISAMPL(I2+1),XAM(I),XPH(I))              00154
      NPTS=16                                                          00155
      KOUNT=1                                                          00156
C                                                                      00157
C     FIND PEAK AND PLOT CONVENTIONAL MAP                             00158
C                                                                      00159
      CALL FNDMAX(XAM,NPTS,KOUNT)                                      00160
      PEAK=XAM(KOUNT)                                                  00161
      PKLG=20.0*ALOG10(PEAK)                                           00162
      DO 300 I=1,16                                                    00163
      IF(XAM(I).LT.1.0E-20)XAM(I)=1.0E-27                             00164
  300 XAM(I)=PKLG-20.0*ALOG10(XAM(I))                                 00165
  502 CALL SSWTCH(2,IUP)                                               00166
      IF(IUP.EQ.1)GO TO 502                                           00167
      CALL BURST                                                       00168
      CALL TKPLOT(0,0,0)                                               00169
      YSTART=1.4                                                       00170
      CALL AXIS(.5,YSTART,IAZ,-11,6.0,0.0,-90.,30.001)               00171
      CALL AXIS(.5,YSTART,IDB,+12,4.0,90.0,-80.0,20.001)             00172
      DO 35 I=1,8                                                     00173
   35 YPOINT(I)=XAM(I+8)                                              00174
      DO 36 I=9,17                                                    00175
   36 YPOINT(I)=XAM(I-8)                                              00176
      DO 33 I=1,17                                                    00177
      X=XPOINT(I)                                                     00178
      Y=(YSTART+4.0)-(YPOINT(I)/20.0)                                00179
      IF(Y.LT.YSTART)Y=YSTART                                        00180
      IF(I.GT.1)GO TO 34                                             00181
      CALL PLOT(X,Y,3)                                               00182
      GO TO 33                                                        00183
   34 CALL PLOT(X,Y,2)                                               00184
```

```
   33 CONTINUE                                                              00185
      CALL PLOT(XUR,YSTART+.1,3)                                            00186
      CALL PLOT(XUR,YSTART,2)                                               00187
      CALL PLOT(XUL,YSTART+.1,3)                                            00188
      CALL PLOT(XUL,YSTART,2)                                               00189
      CALL PLOT(0.0,0.5,-1)                                                 00190
      WRITE(13,102)(CTIME(I),I=1,5),ICOLON,CTIME(6),KMAX                    00191
  102 FORMAT(9X,'SAMPLE TIME',3X,3A2,3X,2A2,A1,A2,9X,'KMAX=',I2)            00192
      CALL TKWAIT                                                           00193
C                                                                          00194
C   SS2 UP = WAIT                                                          00195
C                                                                          00196
  600 CALL SSWTCH(2,IUP)                                                    00197
      IF(IUP.EQ.1)GO TO 600                                                00198
C   SS1 DOWN=CONTINUE PROCESSING        UP=INPUT NEW TIME                  00199
C   SS1 UP=CONTINUE PROCESSING                                             00200
C                                                                          00201
      CALL SSWTCH(1,IUP)                                                    00202
      IF(IUP.EQ.1)GO TO 1                                                   00203
      GO TO 2                                                               00204
SCONVT      EQU     F.MAIN          NAME THE PROGRAM CONVT                 00205
S           NTRY    CONVT                                                  00206
S           LIBR    CONVT                                                  00207
      END                                                                  00208
```

```
      SUBROUTINE RDTAPE(IFILE)                                        00210
S         NTRY   RDTAPE                                               00211
S         LIBR   RDTAPE                                               00212
C                                                                    00213
C     TAPE READ ROUTINE FOR CORRECTION FACTORS GENERATION ONLY USING  00214
C     PROGRAM CALT                                                    00215
C                                                                    00216
      COMMON IBUF1(262),IBUF2(262),INBUF(523)                        00217
      DATA ICOLON/ZBAAA/                                             00218
    5 NWORDS=523                                                     00219
      IUNIT=9                                                         00220
      IEOF=0                                                          00221
   10 CALL INP7(INBUF,NWORDS,IUNIT,IFILE,NWR)                        00222
      IF(IFILE)1,2,3                                                  00223
C     PARITY ERROR ON TAPE                                            00224
    1 WRITE(3,100)NWR                                                 00225
  100 FORMAT(/5X,'TAPE PARITY',I5,'WORDS READ')                      00226
      GO TO 10                                                        00227
C     END OF FILE CONDITION                                           00228
    3 WRITE(3,101)                                                    00229
  101 FORMAT(/5X,'TAPE EOF')                                          00230
      IEOF=IEOF+1                                                     00231
      IF(IEOF.GE.2)STOP                                              00232
      GO TO 10                                                        00233
C     NORMAL READ                                                     00234
    2 IF(NWR.EQ.10)GO TO 4                                           00235
      IF(NWR.NE.523)WRITE(3,102)NWR                                  00236
  102 FORMAT(//15X,23HRECORD LENGTH INCORRECT,I5,11H WORDS READ)      00237
      CALL TIMOVE(INBUF(513))                                        00238
      RETURN                                                          00239
    4 WRITE(13,104)(INBUF(I),I=1,6),ICOLON,INBUF(7)                  00240
  104 FORMAT(//2X,A2,3X,3A2,3X,2A2,A1,A2)                            00241
      IFILE=+1                                                        00242
      GO TO 5                                                         00243
                                                                     00244
```

APPENDIX C
ADAPTIVE ANGULAR POWER DENSITY SPECTRA

```
C      PROGRAM ADAPT                                                      00001
C                                                                         00002
C                                                                         00003
C                                                                         00004
C      THIS PROGRAM IS CALLED  'ADAPT'                                    00005
C      IT GENERATES AND PLOTS A ONE-DIMENSIONAL ADAPTIVE MAP USING THE    00006
C      16 ELEMENT ARRAY AT RADC,  DEXTER, NEW YORK.                       00007
C      READS TAPE INPUT ONLY                                              00008
C                                                                         00009
C      25 AUGUST 1975          1030                                       00010
C                                                                         00011
       REAL IQCORA(16),DELPH(16),BUF(64),SAMPL(32),COSANG(16),TANANG(16)  00012
       REAL AM(16),COS                                                    00013
       INTEGER IAZ(11),IDB(6),STIME(6),DUM(523)                           00014
       COMPLEX ZCORR(16),ZSAMPL,DDLPH(16)                                 00015
C                                                                         00016
       COMMON IBUF1(262),IBUF2(262),INBUF(523),DBPOW(65),MELEM,DUMD(32),  00017
      * AL(272),TOL,VS(32),WT(32),REPI,REPO,AMP,POSD,UTHET,SPEL,MA(64),   00018
      * BL(272)                                                           00019
C                                                                         00020
       EQUIVALENCE (INBUF(1),DUM(1))                                      00021
       EQUIVALENCE (BUF(1),IQCORA(1)),(BUF(17),DELPH(1)),                 00022
      * (BUF(33),ZCORR(1)),(DBPOW(1),SAMPL(1)),(DBPOW(33),COSANG(1)),     00023
      * (DBPOW(49),TANANG(1))                                             00024
C                                                                         00025
       DATA (DDLPH(I),I=1,16)/(0.01266,0.0),(0.05237,0.0),(0.13904,0.0),  00026
      * (0.28431,0.0),(0.48131,0.0),(0.69921,0.0),(0.880,0.0),(1.0,0.0),  00027
      * (1.0,0.0),(0.880,0.0),(0.69921,0.0),(0.48131,0.0),(0.28431,0.0),  00028
      * (0.13904,0.0),(0.05237,0.0),(0.01266,0.0)/                        00029
       DATA(IAZ(I),I=1,11)/7A0A0,7A0A0,7C1DA,7C9CD,7D5D4,7C8A0,7A0A0,     00030
      * 7A0D5,7A0D3,7D0C1,7C3C5/                                          00031
       DATA(IDB(I),I=1,6)/7A0A0,7A0A0,7A0C4,7C2A0,7C4CF,7D7CF/            00032
       DATA PI,RAD,NSAMP,NCHAN,ICOLON/3.14159,57.29578,512,32,7A4A0/      00033
       DATA IDUM/7A0A0/                                                   00034
C                                                                         00035
       ARSIN(DUMMY)=ATAN2(DUMMY,SQRT(1.0-DUMMY**2))                       00036
C                                                                         00037
       TAN(DUMMY)=SIN(DUMMY)/COS(DUMMY)                                   00038
C                                                                         00039
       TOL=1.3E-16                                                        00039
     1 CONTINUE                                                           00040
       DO 22 I=1,272                                                      00041
       AL(I)=0.0                                                          00042
    22 BL(I)=0.0                                                          00043
       IDSPLA=0                                                           00044
C                                                                         00045
C      CHECK SS0  -  IF UP USE FORMER PARAMETERS                          00046
C                                                                         00047
       CALL SSWTCH(0,IUP)                                                 00048
       IF(IUP.EQ.1)GO TO 166                                             00049
       CALL BURST                                                         00050
       WRITE(13,4)                                                        00051
     4 FORMAT(37HMODE?  FREQ?  EL. SPACING? (I2,2F7.3))                   00052
       READ(13,44)MODE,FREQ,SPACE                                        00053
    44 FORMAT(I2,2F7.3)                                                   00054
       IF(MODE.LE.0)GO TO 2                                              00055
       XLAMDA=300.0/FREQ                                                 00056
       SSPL=SPACE/XLAMDA*2.0*PI                                          00057
       SPEL=SSPL                                                          00058
       XK=SSPL/PI                                                        00059
       XU=2.0/XK-1.0                                                     00060
       IF(XU.LE.0.0)GO TO 97
```

```
      IF(XU.GT.1.3)XU=1.0                                            00061
      XANGL=ARSIN(XU)*RAD                                            00062
      GO TO 98                                                       00063
   97 XANGL=3.0                                                      00064
   98 CONTINUE                                                       00065
111   WRITE(13,6)                                                    00066
6     FORMAT(' TIME HR,MIN,SEC; NO OF ELEMENT   (3A2,I3)')           00067
      READ(13,113) IHR,IMIN,ISEC,MELEM                              00068
113   FORMAT(3A2,I3)                                                 00069
      IF(MELEM.GT.16)GO TO 111                                       00070
  112 WRITE(13,8)                                                    00071
8     FORMAT(16HCONFIGURATION  X)                                    00072
      READ(13,9)(MA(I),I=1,16)                                       00073
9     FORMAT(16I1)                                                   00074
      DO 701 I=17,64                                                 00075
701   MA(I)=0                                                        00076
      ISUM=0                                                         00077
      DO 71 I=1,64                                                   00078
   71 ISUM=ISUM+MA(I)                                                00079
      IF(ISUM.EQ.MELEM)GO TO 711                                     00080
      WRITE(13,72)MA                                                 00081
   72 FORMAT(64I1,/22X,19HCONFIGURATION ERROR)                       00082
      GO TO 112                                                      00083
  711 WRITE(13,10)                                                   00084
   10 FORMAT('NGROUP? (I5)')                                         00085
      READ(13,11)NGROUP                                              00086
   11 FORMAT(I5)                                                     00087
      MELEM2=2*MELEM                                                 00088
1167  IFILE=1                                                        00089
      CALL RDTP(IFILE)                                               00090
      CALL TMASCI(STIME)                                             00091
      IF(STIME(4).NE.IHR.OR.STIME(5).NE.IMIN.OR.STIME(6)            00092
     1 .NE.ISEC) GO TO 1167                                          00093
      IFIRST=0                                                       00094
C                                                                    00095
C   RETRIEVE CORRECTION FACTORS FROM DISK                            00096
C   COMPUTE ELEMENTAL PHASE ANGLE CORRECTIONS                        00097
C                                                                    00098
  166 ISECT=1                                                        00099
      CALL DSKIN(BUF,ISECT,64)                                       00100
      DO 91 IEL=1,16                                                 00101
      ANGLR=(90.0-DELPH(IEL))/RAD                                    00102
      COSANG(IEL)=COS(ANGLR)                                         00103
   91 TANANG(IEL)=TAN(ANGLR)                                         00104
      IF(MODE.EQ.2)GO TO 5000                                        00105
C                                                                    00106
C   APPLY CORRECTION FACTORS                                         00107
C                                                                    00108
      DO 93 N=1,NGROUP                                               00109
      CALL RTBDOT(N)                                                 00110
      IF(IFIRST.EQ.0) GO TO 1168                                     00111
      IFILE=+1                                                       00112
      CALL RDTP(IFILE)                                               00113
      CALL TMASCI(STIME)                                             00114
1168  IFIRST=1                                                       00115
      DO 93 NPULSE=1,16                                              00116
      IWORD=32*(NPULSE-1)                                            00117
      DO 912 IEL=1,MELEM                                             00118
      I2=2*IEL                                                       00119
      IDNUM=I2+IWORD                                                 00120
      SAMPL(I2-1)=FLOAT(DUM(IDNUM-1))                                00121
      SAMPL(I2)=FLOAT(DUM(IDNUM))*IQCORA(IEL)/COSANG(IEL)-SAMPL(I2-1) 00122
```

```
      1 *TANANG(IEL)                                                00123
        ZSAMPL=CMPLX(SAMPL(I2-1),SAMPL(I2))*ZCORR(IEL)             00124
        SAMPL(I2-1)=REAL(ZSAMPL)                                   00125
    912 SAMPL(I2)=AIMAG(ZSAMPL)                                    00126
        DO 931 K=1,MELEM2                                          00127
    931 DUMD(K)=SAMPL(K)                                           00128
C                                                                  00129
C     GENERATE THE COVARIANCE MATRIX                               00130
C                                                                  00131
     93 CALL ADCRMT                                                00132
        GO TO 6919                                                 00133
C                                                                  00134
C                          MODE 2                                  00135
C     GET SAMPLES FOR EACH I-Q PAIR, CORRECT, AND APPLY WINDOW     00136
C                                                                  00137
   5909 DO 930 N=1,NGROUP                                          00138
        IFILE=+1                                                   00139
        CALL RDTP(IFILE)                                           00140
        CALL TMASCI(STIME)                                         00141
        DO 6000 IEL=1,MELEM                                        00142
        ICONST=2*IEL-1                                             00143
        DO 6001 J=1,16                                             00144
        JR=ICONST+32*(J-1)                                         00145
        J2=2*J                                                     00146
        SAMPL(J2-1)=FLOAT(DUM(JR))                                 00147
        SAMPL(J2)=FLOAT(DUM(JR+1))*IQCORA(IEL)/COSANG(IEL)-SAMPL(J2-1) 00148
      . *TANANG(IEL)                                               00149
        ZSAMPL=CMPLX(SAMPL(J2-1),SAMPL(J2))*ZCORR(IEL)*DOLPH(J)    00150
        SAMPL(J2-1)=REAL(ZSAMPL)                                   00151
   6001 SAMPL(J2)=AIMAG(ZSAMPL)                                    00152
C                                                                  00153
C     DO COMPLEX FFT  -  DISPLAY THE FIRST SPECTRUM                00154
C                                                                  00155
        CALL FORT(4,-1,SAMPL,IFERR)                                00156
        DO 6002 J=1,16                                             00157
        J2=2*J                                                     00158
        CALL AMP   (SAMPL(J2-1),SAMPL(J2),AM(J),PH)                00159
   6002 AM(J)=AM(J)/3276.7                                         00160
        IF(IDSPLA.GE.1)GO TO 6008                                  00161
        IDSPLA=1                                                   00162
        CALL TKPLOT(0,0,0)                                         00163
    503 CALL SWTCH(2,IUP)                                          00164
        IF(IUP.EQ.1)GO TO 503                                      00165
        CALL BURST                                                 00166
        XSTART=1.5                                                 00167
        YSTART=2.5                                                 00168
        CALL AXIS(XSTART,YSTART,IDUM,-2,4.0,0.0,0.01,4.0)          00169
        CALL AXIS(XSTART,YSTART,IDUM,+2,3.0,90.0,0.01,4.0)         00170
        DO 6003 I=1,16                                             00171
        X=FLOAT(I)/4.0+XSTART                                      00172
        Y=AM(I)/4.0+YSTART                                         00173
        IF(I.GT.1)GO TO 6004                                       00174
        CALL PLOT(X,Y,3)                                           00175
        GO TO 6003                                                 00176
   6004 CALL PLOT(X,Y,2)                                           00177
   6003 CONTINUE                                                   00178
C                                                                  00179
C     NOW CHOOSE DESIRED CELL                                      00180
C                                                                  00181
        CALL PLOT(0,0,1.0,-1)                                      00182
        WRITE(13,203)AM                                            00183
    203 FORMAT(8F7.1)                                              00184
```

```
      WRITE(13,202)                                              00185
  202 FORMAT(/'INPUT CELL NO. (I2)')                             00186
      READ(13,113)ICELL                                          00187
      JCELL=2*ICELL-1                                            00188
 6008 DUMD(ICONST)=SAMPL(JCELL)                                  00189
      DUMD(ICONST+1)=SAMPL(JCELL+1)                              00190
 6009 CONTINUE                                                   00191
C                                                                00192
C     GENERATE COVARIANCE MATRIX                                 00193
C                                                                00194
  930 CALL ADCRMT                                                00195
 6010 CONTINUE                                                   00196
C                                                                00197
C                                                                00198
C                                                                00199
C     INVERT THE COVARIANCE MATRIX                               00200
C                                                                00201
      DO 94 I=1,272                                              00202
   94 BL(I)=AL(I)                                                00203
      CALL CHLKYA                                                00204
      CALL INVTL                                                 00205
      CALL HINVL                                                 00206
C                                                                00207
C     CHECK GOODNESS                                             00208
C                                                                00209
      CALL MULHM                                                 00210
      CALL PRPKE                                                 00211
      AMP=1.0                                                    00212
C                                                                00213
C                                                                00214
C                                                                00215
C     64 STEERS + BORESITE = 65 TOTAL LOOKS                      00216
C                                                                00217
C     DO ALL STEERS EXECPT BORESITE.  BEGIN AT U=-1 AND STEP ALONG 00218
C     TOWARDS BORESITE.  FOR EACH -AZIMUTH DO A +AZIMUTH BY SETTING 00219
C     IMAGINARY PART OF STEER VECTOR VS TO A - VALUE AND CONTINUE.  00220
C                                                                00221
      UINCR=2.0/64.0                                             00222
      USTART=-1.0                                                00223
      DO 75 I=1,32                                               00224
      CALL RIBDOT(I)                                             00225
      FI=FLOAT(I-1)                                              00226
      UTHET=USTART+(FI*UINCR)                                    00227
      CALL SGEN3                                                 00228
      DO 96 K=1,MELEM2                                           00229
   96 VS(K)=DUMD(K)                                              00230
      CALL HXV                                                   00231
      CALL VSRXW                                                 00232
      DBPOW(I)=1.0/REPI                                          00233
C                                                                00234
C     DO + SIDE OF AZIMUTH                                       00235
C                                                                00236
      DO 64 K=1,MELEM                                            00237
   64 VS(2*K)=-VS(2*K)                                           00238
      CALL HXV                                                   00239
      CALL VSRXW                                                 00240
      ISUB=66-I                                                  00241
   75 DBPOW(ISUB)=1.0/REPI                                       00242
C                                                                00243
C     FINISHED ALL STEERS.  NOW DO BORESITE                      00244
C                                                                00245
      DO 65 K=1,MELEM                                            00246
```

```
      K2=2*K                                                      00247
      VS(K2-1)=1.7                                                00248
   65 VS(K2)=7.7                                                  00249
      CALL MXV                                                    00250
      CALL VSRX4                                                  00251
      DBPOW(33)=1.2/REPI                                          00252
      PEAK=DBPOW(1)                                               00253
      DO 123 I=2,65                                               00254
      IF(DBPOW(I).GT.PEAK)PEAK=DBPOW(I)                           00255
  123 CONTINUE                                                    00256
      PKLG=17.7*ALOG17(PEAK)                                      00257
      DO 134 I=1,65                                               00258
      IF(DBPOW(I).LT.1.2E-28)DBPOW(I)=1.2E-28                     00259
  134 DBPOW(I)=PKLG-12.2*ALOG17(DBPOW(I))                         00260
      WRITE(13,231)DBPOW                                          00261
  231 FORMAT(/1X,13H DBPOW',22(/2RF9.1))                          00262
C                                                                 00263
C     PLOT THE ADAPTIVE MAP                                       00264
C                                                                 00265
  522 CALL SSWTCH(2,IUP)                                          00266
      IF(IUP.EQ.1)GO TO 500                                       00267
      CALL RWRST                                                  00268
      CALL TXPLOT(7,7,7)                                          00269
      XSTART=7.5                                                  00270
      YSTART=1.4                                                  00271
      CALL AXIS(XSTART,YSTART,IAZ,-11,6.,7.,-97.,30.001)          00272
      CALL AXIS(XSTART,YSTART,IDB,+12,4.7,90.0,-80.0,20.001)      00273
      DO 135 I=1,65                                               00274
      XX=FLOAT(I-33)/32.                                          00275
      X=3.5+SIGN(3.,XX)                                           00276
      IF(ABS(XX).LT.1.) X=3.5+ARSIN(XX)*RAD/30.                   00277
      Y=(YSTART+4.0)-(DBPOW(I)/20.0)                              00278
      IF(Y.LT.YSTART)Y=YSTART                                     00279
      IF(I.GT.1)GO TO 1041                                        00280
      CALL PLOT(X,Y,3)                                            00281
      GO TO 135                                                   00282
 1041 CALL PLOT(X,Y,2)                                            00283
  135 CONTINUE                                                    00284
      XMOV=XANGL/30.                                              00285
      XMID=XSTART+3.0                                             00286
      XULEFT=XMID-XMOV                                            00287
      XURITE=XMID+XMOV                                            00288
      CALL PLOT(XULEFT,YSTART+7.1,3)                              00289
      CALL PLOT(XULEFT,YSTART,2)                                  00290
      CALL PLOT(XURITE,YSTART+7.1,3)                              00291
      CALL PLOT(XURITE,YSTART,2)                                  00292
      CALL PLOT(7.0,7.8,-1)                                       00293
      WRITE(13,132)MODE,MELEM,SPACE,FREQ,XANGL,(STIME(I),I=1,5),ICOLON,  00294
     * STIME(6),NGROUP                                            00295
  132 FORMAT(12X,4HMODE,I2,5X,I2,9H ELEMENTS,5X,7HSPACING,F7.3,   00296
     * 7H METERS,/12X,4HFREQ,F7.3,4H MHZ,12X,6HLIMITS,F5.1,8H DEGREES,  00297
     * /12X,13HSAMPLE TIME   ,3A2,3X,2A2,A1,A2,5X,'NGROUP=',I4)   00298
  501 CALL SSWTCH(2,IUP)                                          00299
      IF(IUP.EQ.1)GO TO 501                                       00300
      GO TO 1                                                     00301
    2 STOP                                                        00302
SADAPT    EQU   F.MAIN         NAMES THE PROGRAM ADAPT           00303
S         NTRY  ADAPT                                            00304
S         LIBR  ADAPT                                            00305
      END                                                        00306
```

```
      SUBROUTINE RDTP(IFILE)                                          00308
S        NTRY   RDTP                                                  00309
S        LIBR   RDTP                                                  00310
      COMMON IBUF1(262),IBUF2(262),INBUF(523),DRPOW(65),MELEM,        00311
     *  DUMD(32),AL(272),TOL,VS(32),WT(32),REPI,REPQ,AMP,POSD,        00312
     *  UTHET,SPEL,MA(64),BL(272)                                     00313
      DATA ICOLON/ZBAA0/                                              00314
    5 NWORDS=523                                                      00315
      IUNIT=9                                                         00316
      IEOF=0                                                          00317
   10 CALL INP7(INBUF,NWORDS,IUNIT,IFILE,NWR)                         00318
      IF(IFILE)1,2,3                                                  00319
C     PARITY ERROR ON TAPE                                            00320
    1 WRITE(13,100)NWR                                                00321
  100 FORMAT(/5X,'TAPE PARITY',I5,'WORDS READ')                       00322
      GO TO 10                                                        00323
C     END OF FILE CONDITION                                           00324
    3 WRITE(13,101)                                                   00325
  101 FORMAT(/5X,'TAPE EOF')                                          00326
      IEOF=IEOF+1                                                     00327
      IF(IEOF.GE.2)STOP                                               00328
      GO TO 10                                                        00329
C     NORMAL READ                                                     00330
    2 IF(NWR.EQ.10)GO TO 4                                            00331
      IF(NWR.NE.523)WRITE(3,102)NWR                                   00332
  102 FORMAT(//15X,23HRECORD LENGTH INCORRECT,I5,11H WORDS READ)      00333
      CALL TIMOVE(INBUF(513))                                         00334
      RETURN                                                          00335
    4 CONTINUE                                                        00336
      WRITE(13,104)(INBUF(I),I=1,6),ICOLON,INBUF(7)                   00337
  104 FORMAT(//2X,A2,3X,3A2,3X,2A2,A1,A2)                             00338
      IFILE=+1                                                        00339
      GO TO 5                                                         00340
                                                                     00341
```

APPENDIX D
RADAR PROCESSING WITH CONVENTIONAL BEAMFORMING

```
C      PROGRAM RCONVT                                                    00001
C                                                                        00002
C                                                                        00003
C      THIS PROGRAM IS CALLED 'RCONVT'                                   00004
C      RETRIEVES CORRECTION FACTORS FROM DISK (PREVIOUSLY GENERATED BY   00005
C      PROGRAM 'MCALT'), READS DATA AND APPLIES SAID CORRECTION          00006
C      FACTORS, COMPUTES AND PLOTS CONVENTIONAL DOPPLER SPECTRA ON THE TEK. 00007
C      CRT USING DATA COLLECTED ON THE                                   00008
C      16 ELEMENT ARRAY AT RADC,  DEXTER, NEW YORK.                      00009
C      READS TAPE INPUT ONLY                                             00010
C                                                                        00011
C      17 SEPTEMBER 1975         1500                                    00012
C                                                                        00013
       REAL ISAMPL(32),IQCORA(16),DELPH(15),BUF(64),COSANG(16),          00014
      * TANANG(16),XAM(16),XPH(16)                                       00015
      *,FFTD(512)                                                        00016
       COMMON IBUF1(262),IBUF2(262),INBUF(523),DBPOW(65),MELEM,DUMD(32), 00017
      * AL(272),TOL,VS(32),WT(32),REPT,REPQ,AMP,POSD,UTHFT,SPEL,MA(64),  00018
      * BL(272)                                                          00019
       INTEGER CTIME(6),WBUF(523),IZ(6),IDB(6)                           00020
       COMPLEX ZCORR(16),ZTEMP(16),DOLPH(16),ZSAMPL                      00021
      *  ,STWT(16)                                                       00022
C                                                                        00023
       REAL COS,AM(16),PH(16),YPOINT(16)                                 00024
       REAL DLPTIM(248)                                                  00025
       INTEGER IPT(5)                                                    00026
       EQUIVALENCE (INBUF(1),WBUF(1))                                    00027
C                                                                        00028
       EQUIVALENCE (BUF(1),IQCORA(1)),(BUF(17),DELPH(1)),                00029
      * (BUF(33),ZCORR(1))                                               00030
C                                                                        00031
       DATA (DOLPH(I),I=1,16)/(0.01266,0.0),(0.05237,0.0),(0.13004,0.0), 00032
      * (0.28431,0.0),(0.48131,0.0),(0.69921,0.0),(0.889,0.0),(1.0,0.0), 00033
      * (1.0,0.0),(0.889,0.0),(0.69921,0.0),(0.48131,0.0),(0.28431,0.0), 00034
      * (0.13004,0.0),(0.05237,0.0),(0.01266,0.0)/                       00035
       DATA (IZ(I),I=1,6)/Z0A0A0,Z0A0A0,Z0A0C1,Z0AC9,ZCDD5,ZD4CB/        00036
       DATA(IDB(I),I=1,6)/Z0A0A0,Z0A0A0,Z0A0C4,ZC2A0,ZC4CF,ZD7CE/        00037
       DATA PI,RAD,NSAMP,NCHAN,ICOLON/3.14159,57.29578,512,32,Z84A0/     00038
       DATA IDUM/Z0A0A0/                                                 00039
       DATA IPT/0,8,24,56,120/                                          00040
       DATA NTP/0/                                                       00041
C                                                                        00042
       TAN(DUMMY)=SIN(DUMMY)/COS(DUMMY)                                  00043

       ARSIN(DUMMY)=ATAN(DUMMY/SQRT(1.-DUMMY**2))                        00044

C                                                                        00045
COMPUTE DOLPH WEIGHTS                                                    00046
       DO 911 M=4,8                                                      00047
       II=IPT(M-3)+1                                                     00048
       N=2**M                                                            00049
       CALL RIBDOT(N)                                                    00050
911    CALL DLPH(DLPTIM(II),N,70.,INDQ)                                  00051
C      RETRIEVE CORRECTION FACTORS FROM DISK                             00052
C      COMPUTE ELEMENTAL PHASE ANGLE CORRECTIONS                         00053
C                                                                        00054
       ISECT=1                                                          00055
       CALL DSKIN(BUF,ISECT,64)                                          00056
       DO 91 IEL=1,16                                                    00057
       ANGLR=(90.0-DELPH(IEL))/RAD                                       00058
       COSANG(IEL)=COS(ANGLR)                                            00059
    91 TANANG(IEL)=TAN(ANGLR)                                            00060
```

```
C                                                                          00061
C       INPUT DESIRED TIME AND SEARCH TAPE FOR IT                         00062
C                                                                          00063
     1 CALL BURST                                                          00064
C                                                                          00065
C       CHECK SS0  -  IF UP USE FORMER PARAMETERS                         00066
C                                                                          00067
       CALL SSWTCH(0,IUP)                                                  00068
       IF(IUP.EQ.1) GO TO 711                                             00069
       WRITE(13,4)                                                         00070
  4    FORMAT(' INPUT FREQ (F7.3)')                                       00071
       READ(13,44) FREQ                                                    00072
  44   FORMAT(F7.3)                                                        00073
       SPACE=18.288                                                        00074
       XLAMDA=300.0/FREQ                                                   00075
       SSPL=SPACE/XLAMDA*2.0*PI                                            00076
       SPEL=SSPL                                                           00077
       XK=SSPL/PI                                                          00078
       XU=2.0/XK-1.0                                                       00079
       IF(XU.LE.0.0)GO TO 97                                              00080
       IF(XU.GT.1.0)XU=1.0                                                00081
       XANGL=ARSIN(XU)*RAD                                                00082
       GO TO 98                                                           00083
  97   XANGL=0.0                                                          00084
  98   CONTINUE                                                            00085
       MELEM=16                                                            00086
       DO 71 I=1,16                                                        00087
  71   MA(I)=1                                                             00088
       DO 72 I=17,64                                                       00089
  72   MA(I)=0                                                            00090
       ISUM=16                                                            00091
 711   MELEM2=2*MELEM                                                      00092
       WRITE(13,100)                                                       00093
 100   FORMAT('INPUT DESIRED TIME HR,MIN,SEC(3A2)')                       00094
       READ(13,101)IHR,IMIN,ISEC                                          00095
 101   FORMAT(3A2)                                                         00096
       WRITE(13,1111)                                                      00097
1111   FORMAT(' INPUT LOG BASE 2 OF NTIMES, STEER(I1,F7.3)')              00098
       READ(13,1112) MTIMES,STEER                                         00099
1112   FORMAT(I1,F7.3)                                                     00100
       UTHET=SIN(STEER/RAD)                                               00101
       POSD=UTHET                                                          00102
       NTIMES=2**MTIMES                                                    00103
       CALL SGEN3                                                          00104
       NNT=NTIMES/16                                                       00105
       DO 1113 K=1,MELEM                                                   00106
       K2=2*K                                                              00107
1113   STWT(K)=CMPLX(DUMD(K2-1),-DUMD(K2))                               00108
  10   IFILE=+1                                                            00109
  11   CALL RDTAPE(IFILE)                                                  00110
       CALL TMASCI(CTIME)                                                  00111
       IF(CTIME(4).NE.IHR.OR.CTIME(5).NE.IMIN.OR.CTIME(6).NE.            00112
      1 ISEC) GO TO 10                                                    00113
1120   DO 6000 ITIMES=1,NNT                                               00114
       CALL RIBDOT(ITIMES)                                                00115
       IF(ITIMES.EQ.1) GO TO 15                                          00116
       CALL RDTAPE(IFILE)                                                 00117
       CALL TMASCI(CTIME)                                                 00118
  15   DO 16 I=1,NSAMP                                                    00119
  16   WBUF(I)=FLOAT(INBUF(I))                                           00120
C                                                                          00121
C       APPLY ALL CORRECTION FACTORS TO NEW SAMPLES, ADD WEIGHTS AND      00122
```

```
C     STEER AND STORE                                               00123
C                                                                   00124
      ITT=(ITIMES-1)*32                                             00125
      DO 5995 IE=1,32                                               00126
      II=IE+ITT                                                     00127
5995  FFTD(II)=0.                                                   00128
      DO 6000 IEL=1,16                                              00129
      ICONST=2*IEL-1                                                00130
      DO 6001 I=1,16                                                00131
      IRXWD=ICONST+32*(I-1)                                         00132
      I2=2*I                                                        00133
      I2M=I2-1                                                      00134
      ISAMPL(I2M)=WBUF(IRXWD)                                       00135
      ISAMPL(I2)=WBUF(IRXWD+1)*TQCORA(IFL)/COSANG(IFL)-             00136
     1 ISAMPL(I2M)*TANANG(IEL)                                      00137
      ZSAMPL=CMPLX(ISAMPL(I2M),ISAMPL(I2))*ZCORR(IFL)*DOLPH(IEL)    00138
     1  *STWT(IEL)                                                  00139
      II=I2+ITT                                                     00140
      FFTD(II-1)=REAL(ZSAMPL)+FFTD(II-1)                            00141
6001  FFTD(II)=AIMAG(ZSAMPL)+FFTD(II)                               00142
6000  CONTINUE                                                      00143
C  IF DESIRED, TIME SERIES MAY BE WRITTEN ON TAPE HERE              00144
C                                                                   00145
C     MULTIPLY BY DOLPH WEIGHTS                                     00146
      IP=IPT(MTIMES-3)                                              00147
      DO 6005 I=1,NTIMES                                            00148
      I2=2*I                                                        00149
      II=I+IP                                                       00150
      IF(I2.GT.NTIMES) II=NTIMES+1-I+IP                             00151
      FFTD(I2-1)=FFTD(I2-1)*DLPTIM(II)                              00152
6005  FFTD(I2)=FFTD(I2)*DLPTIM(II)                                  00153
C                                                                   00154
C     TAKE FFT AND PLOT SPECTRUM                                    00155
      CALL FORT2(MTIMES,-1,FFTD,IERRR)                              00156
502   CALL SSWTCH(2,IUP)                                            00157
      IF(IUP.EQ.1)GO TO 502                                         00158
      CALL BURST                                                    00159
      CALL TKPLOT(0,0,0)                                            00160
      YSTART=1.4                                                    00161
      XSTART=.5                                                     00162
      CALL AXIS(XSTART,YSTART,IDB,12,4.0,90.0,-80.0,20.001)         00163
      CALL PLOT(XSTART,YSTART-.07,3)                                00164
      DO 5021 I=1,8                                                 00165
      CALL PLOT(XSTART,YSTART,2)                                    00166
      XSTART=XSTART+.75                                             00167
      CALL PLOT(XSTART,YSTART,2)                                    00168
      CALL PLOT(XSTART,YSTART-.07,2)                                00169
5021  CONTINUE                                                      00170
      NSTR=NTIMES/2                                                 00171
      NSTP=NSTR/4                                                   00172
      XSTART=XSTART-.1                                              00173
      YSTART=1.2                                                    00174
      DO 5022 I=1,9                                                 00175
      FN=NSTR+.1*ISIGN(1,NSTR)                                      00176
      CALL NUMBER(XSTART,YSTART,.1,FN,0.,-1)                        00177
      NSTR=NSTR-NSTP                                                00178
5022  XSTART=XSTART-.75                                            00179
      XSTART=.5                                                     00180
      YSTART=1.4                                                    00181
      NP2=NTIMES/2                                                  00182
      SCN=6./FLOAT(NTIMES)                                          00183
      PEAK=0.                                                       00184
```

```
      DO 5023 I=1,NTIMES                                              00185
      J=2*I                                                           00186
      FFTD(I)=FFTD(J-1)**2+FFTD(J)**2                                 00187
5023  PEAK=AMAX1(PEAK,FFTD(I))                                        00188
      SHFT=YSTART+4.-ALOG10(PEAK)*.5                                  00189
      DBMIN=PEAK*1.E-8                                                00190
      IPEN=3                                                          00191
      X=XSTART                                                        00192
      DO 5024 I=1,NP2                                                 00193
      J=I+NP2                                                         00194
      Y=YSTART                                                        00195
      IF(FFTD(J).GT.DBMIN) Y=SHFT+ALOG10(FFTD(J))*.5                  00196
      CALL PLOT(X,Y,IPEN)                                             00197
      X=X+SCN                                                         00198
5024  IPEN=2                                                          00199
      NP2=NP2+1                                                       00200
      DO 5025 I=1,NP2                                                 00201
      Y=YSTART                                                        00202
      IF(FFTD(I).GT.DBMIN) Y=SHFT+ALOG10(FFTD(I))*.5                  00203
      CALL PLOT(X,Y,2)                                                00204
5025  X=X+SCN                                                         00205
      CALL PLOT(0.,.5,-1)                                             00206
      PKDB=10.*ALOG10(PEAK)                                           00207
      WRITE(13,102) (CTIME(I),I=1,5),ICOLON,CTIME(6),STEER,PKDB       00208
102   FORMAT(5X,'SAMPLE TIME  ',3A2,2X,2A2,A1,A2,3X,'STEER=',F7.3,    00209
     1 ', PEAK=',F7.3,' DB'/19X,'USING CONVENTIONAL WEIGHTS')         00210
      CALL TKWAIT                                                     00211
C                                                                     00212
C     SS2 UP = WAIT                                                   00213
C                                                                     00214
  600 CALL SSWTCH(2,IUP)                                              00215
      IF(IUP.EQ.1)GO TO 600                                           00216
C     SS1 DOWN=CONTINUE PROCESSING         UP=INPUT NEW TIME          00217
C     SS1 UP=CONTINUE PROCESSING                                      00218
C                                                                     00219
      CALL SSWTCH(1,IUP)                                              00220
      IF(IUP.EQ.1)GO TO 1                                             00221
      IFILE=1                                                         00222
      CALL RDTAPE(IFILE)                                              00223
      CALL TMASCT(CTIME)                                              00224
      GO TO 1120                                                      00225
SRCONVT      EQU    F.MAIN                                            00226
S            NTRY   RCONVT                                            00227
S            LIBR   RCONVT                                            00228
      END                                                            00229
```

```
      SUBROUTINE FORT2(M,IFS,A,IFERR)                                    00231
S       LIBR    FORT2                                                    00232
      DIMENSION A(512),S(128),K(16)                                      00233
      EQUIVALENCE (K(15),K1),(K(14),K2),(K(13),K3),(K(12),K4)            00234
      EQUIVALENCE (K(11),K5),(K(10),K6),(K( 9),K7),(K( 8),K8)            00235
      EQUIVALENCE (K( 7),K9 ),(K( 6),K10),(K( 5),K11),(K( 4),K12)        00236
      EQUIVALENCE (K( 3),K13),(K( 2),K14),(K( 1),K15)                    00237
      DATA NP/0/                                                         00238
      IF(M)2,2,3                                                         00239
    3 IF(M-15) 5,5,2                                                     00240
    2 IFERR=1                                                            00241
    1 RETURN                                                             00242
    5 IFERR=0                                                            00243
      N=2**M                                                             00244
   10 IF( N-NP )20,20,12                                                 00245
   12 IFERR=1                                                            00246
      GO TO 200                                                          00247
   20 K(1)=2*N                                                           00248
      N2 = K(1)                                                          00249
      DO 22 L=2,M                                                        00250
   22 K(L)=K(L-1)/2                                                      00251
      DO 24 L=M,14                                                       00252
   24 K(L+1)=2                                                           00253
      IJ=2                                                               00254
      J3 = 2                                                             00255
      DO 30 J4=J3,K4,K3                                                  00256
      DO 30 J5=J4,K5,K4                                                  00257
      DO 30 J6=J5,K6,K5                                                  00258
      DO 30 J7=J6,K7,K6                                                  00259
      DO 30 J8=J7,K8,K7                                                  00260
      DO 30 J9=J8,K9,K8                                                  00261
      DO 30 J10=J9,K10,K9                                                00262
      DO 30 J11=J10,K11,K10                                              00263
      DO 30 J12=J11,K12,K11                                              00264
      DO 30 J13=J12,K13,K12                                              00265
      J14=J13                                                            00266
   26 JI=J14                                                             00267
   27 IF(IJ-JI)28,29,29                                                  00268
   28 T=A(IJ-1 )                                                         00269
      A(IJ-1)=A(JI-1)                                                    00270
      A(JI-1)=T                                                          00271
      T=A(IJ)                                                            00272
      A(IJ)=A(JI)                                                        00273
      A(JI)=T                                                            00274
   29 IJ=IJ+2                                                            00275
      JI=JI+K14                                                          00276
      IF(JI.LE.K15) GO TO 27                                             00277
      J14=J14+K13                                                        00278
      IF(J14.LE.K14) GO TO 26                                            00279
   30 CONTINUE                                                           00280
      IF(IFS)32,2,36                                                     00281
   32 FN=N                                                               00282
      DO 34 I=1,N                                                        00283
      A(2*I-1) = A(2*I-1)/FN                                             00284
   34 A(2*I)=-A(2*I)/FN                                                  00285
   36 DO 40 I=1,N,2                                                      00286
      T = A(2*I-1)                                                       00287
      A(2*I-1) =T + A(2*I+1)                                             00288
      A(2*I+1)=T-A(2*I+1)                                                00289
      T=A(2*I)                                                           00290
      A(2*I) = T + A(2*I+2)                                              00291
   40 A(2*I+2)= T - A(2*I+2)                                             00292
```

```
      IF(M-1) 2,1 ,50                                        00293
50 LEXP1=2                                                   00294
   LEXP=0                                                    00295
   NPL= 2**MT                                                00296
60 DO 130 L=2,M                                              00297
   DO 80 I=2,N2,LEXP                                         00298
   I1=I + LEXP1                                              00299
   I2=I1+ LEXP1                                              00300
   I3 =I2+LEXP1                                              00301
   T=A(I-1)                                                  00302
   A(I-1) = T +A(I2-1)                                       00303
   A(I2-1) = T-A(I2-1)                                       00304
   T =A(I)                                                   00305
   A(I) = T+A(I2)                                            00306
   A(I2) = T-A(I2)                                           00307
   T= -A(I3)                                                 00308
   TI = A(I3-1)                                              00309
   A(I3-1) =A(I1-1) - T                                      00310
   A(I3  ) = A(I1 )    - TI                                  00311
   A(I1-1) = A(I1-1) +T                                      00312
80 A(I1)    = A(I1   ) +TI                                   00313
   IF(L-2) 120,120,90                                        00314
90 KLAST=N2-LEXP                                             00315
   JJ=NPL                                                    00316
   DO 110 J=4,LEXP1,2                                        00317
   NPJJ=NT-JJ                                                00318
   UR=S(NPJJ)                                                00319
   UI=S(JJ)                                                  00320
   ILAST=J+KLAST                                             00321
   DO 100 I= J,ILAST,LEXP                                    00322
   I1=I+LEXP1                                                00323
   I2=I1+LEXP1                                               00324
   I3=I2+LEXP1                                               00325
   T=A(I2-1)*UR-A(I2)*UI                                     00326
   TI=A(I2-1)*UI+A(I2)*UR                                    00327
   A(I2-1)=A(I-1)-T                                          00328
   A(I2 )=A(I    ) - TI                                      00329
   A(I-1) =A(I-1)+T                                          00330
   A(I)    =A(I)+TI                                          00331
   T=-A(I3-1)*UI-A(I3)*UR                                    00332
   TI=A(I3-1)*UR-A(I3)*UI                                    00333
   A(I3-1)=A(I1-1)-T                                         00334
   A(I3)    =A(I1  )-TI                                      00335
   A(I1-1)=A(I1-1)+T                                         00336
100 A(I1)   =A(I1   ) +TI                                    00337
110 JJ=JJ+NPL                                                00338
120 LEXP1=2*LEXP1                                            00339
   LEXP = 2*LEXP                                             00340
   NPL = NPL/2                                               00341
130 CONTINUE                                                 00342
140 IF(IFS)145,2,1                                           00343
145 DO 150 I=1,N                                             00344
150 A(2*I) =-A(2*I)                                          00345
160 GO TO 1                                                  00346
200 NP=N                                                     00347
   MP=M                                                      00348
   NT=N/4                                                    00349
   MT=M-2                                                    00350
   IF(MT)260,260,205                                         00351
205 THETA=.7853981634                                        00352
210 JSTEP = NT                                               00353
   JDIF = NT/2                                               00354
```

```
      S(JDIF) = SIN(THETA)                              00355
      IF (MT-2)260,220,220                              00356
220   DO 250 L=2,MT                                     00357
      THETA = THETA/2.                                  00358
      JSTEP2 = JSTEP                                    00359
      JSTEP = JDIF                                      00360
      JDIF = JDIF/2                                     00361
      S(JDIF)=SIN(THETA)                                00362
      JC1=NT-JDIF                                       00363
      S(JC1)=COS(THETA)                                 00364
      JLAST=NT-JSTEP2                                   00365
      IF(JLAST-JSTEP)250,230,230                        00366
230   DO 240 J=JSTEP,JLAST,JSTEP                        00367
      JC=NT-J                                           00368
      JD=J+JDIF                                         00369
240   S(JD)=S(J)*S(JC1)+S(JDIF)*S(JC)                   00370
250   CONTINUE                                          00371
260   IF(IFS)20,1,20                                    00372
      END                                              00373
```

```
      SUBROUTINE DLPH(WT,N,SLL,INDQ)                              00375
S         LIBR    DLPH                                           00376
      DIMENSION WT(256)                                          00377
      IF(N.EQ.1)  GO TO 310                                      00378
C     N IS FULL WINDOW SIZE, EVEN OR ODD                         00379
C     COMPUTES HALF WINDOW, EVEN OR ODD                          00380
C     N IS INTEGER,   SLL IS REAL                                00381
C     IF INDQ IS SET TO 1   POSSIBLE OVERFLOW                    00382
C      RESULTS NOT NEC. VALID                                    00383
      FN = FLOAT(N)                                              00384
      S = 10.**(SLL/20.)                                         00385
      VAR1 = ALOG(S+SQRT(S**2-1.))                               00386
      AA=EXP(2.*VAR1/(FN-1.))                                    00387
      A=((AA-1.)/(AA+1.))**2                                     00388
      WT(1) = 1.                                                 00389
      N2 = (N+1)/2                                               00390
      INDQ=0                                                     00391
      DO 300 K = 2,N2                                            00392
      FK = FLOAT(K)                                              00393
      B = 0.0                                                    00394
      K1 = K-1                                                   00395
      CD=1.                                                      00396
      DO 280 J = 1,K1                                            00397
      FJ = FLOAT(J)                                              00398
      IF(J.NE.1) CD=CD*((FK-FJ)/(FJ-1.))                         00399
      CD=CD*A*((FN-FK+1.-FJ)/FJ)                                 00400
      IF(CD.GT.1.E35) GO TO 285                                  00401
280   B=B+CD                                                     00402
      GO TO 290                                                  00403
285   INDQ=1                                                     00404
290   WT(K) = (FN-1.)*B/(FN-FK)                                  00405
300   CONTINUE                                                   00406
      DO 315 K = 1,N2                                            00407
315   WT(K) = WT(K)/WT(N2)                                       00408
      RETURN                                                     00409
310   WT(1)=1.                                                   00410
      RETURN                                                     00411
      END                                                        00412
```

APPENDIX E
RADAR PROCESSING WITH ADAPTIVE BEAMFORMING

```
C       PROGRAM RADAPT                                                   00001
C                                                                        00002
C                                                                        00003
C       THIS PROGRAM IS CALLED 'RADAPT'  IT GENERATES ADAPTIVE WEIGHTS   00004
C       AND APPLIES THEM TO GENERATE DOPPLER SPECTRA,USING DATA FROM THE 00005
C       16 ELEMENT ARRAY AT RADC,  DEXTER, NEW YORK.                     00006
C       READS TAPE INPUT ONLY                                            00007
C                                                                        00008
C       23 SEPTEMBER 1975          1500                                  00009
C                                                                        00010
        REAL IQCORA(16),DELPH(16),BUF(64),SAMPL(32),COSANG(16),TANANG(16)00011
        REAL AM(16),COS                                                  00012
        INTEGER IAZ(11),IDB(6),STIME(6),DUM(523)                         00013
        COMPLEX ZCORR(16),ZSAMPL,DOLPH(16)                               00014
        COMPLEX STWT(16)                                                 00015
        INTEGER WBUF(523),CTIME(6)                                       00016
        REAL FFTD(512),TSAMPL(32)                                        00017
        DIMENSION DLPTIM(248),IPT(5)                                     00018
C                                                                        00019
        COMMON IBUF1(262),IBUF2(262),INBUF(523),DRPOW(65),MELEM,DUMD(32),00020
      * AL(272),TOL,VS(32),WT(32),REPI,REPQ,AMP,POSD,UTHET,SPEL,MA(64),  00021
      * BL(272)                                                          00022
C                                                                        00023
        EQUIVALENCE (INBUF(1),DUM(1),WBUF(1)),(CTIME(1),STIME(1))        00024
        EQUIVALENCE (BUF(1),IQCORA(1)),(BUF(17),DELPH(1)),               00025
      * (BUF(33),ZCORR(1)),(DRPOW(1),SAMPL(1)),(DRPOW(33),COSANG(1)),    00026
      * (DRPOW(49),TANANG(1))                                            00027
C                                                                        00028
        DATA (DOLPH(I),I=1,16)/(0.01266,0.0),(0.05237,0.0),(0.13904,0.0),00029
      * (0.28431,0.0),(0.48131,0.0),(0.69921,0.0),(0.889,0.0),(1.0,0.0), 00030
      * (1.0,0.0),(0.889,0.0),(0.69921,0.0),(0.48131,0.0),(0.28431,0.0), 00031
      * (0.13904,0.0),(0.05237,0.0),(0.01266,0.0)/                       00032
        DATA(IAZ(I),I=1,11)/Z0000,Z0000,ZC1DA,ZC9CD,ZD5D4,ZC8A0,Z0000,   00033
      * Z0005,Z0003,ZD0C1,ZC3C5/                                         00034
        DATA(IDB(I),I=1,6)/Z0000,Z0000,Z00C4,ZC2A0,ZC4CF,ZD7CE/          00035
        DATA PI,RAD,NSAMP,NCHAN,ICOLON/3.14159,57.29578,512,32,ZBAA0/    00036
        DATA IDUM/Z0000/                                                 00037
        DATA NTP/0/                                                      00038
        DATA IPT/0,8,24,56,120/                                          00039
C                                                                        00040
        ARSIN(DUMMY)=ATAN2(DUMMY,SQRT(1.0-DUMMY**2))                     00041
        TAN(DUMMY)=SIN(DUMMY)/COS(DUMMY)                                 00042
C                                                                        00043
        DO 911 M=4,8                                                     00044
        II=IPT(M-3)+1                                                    00045
        N=2**M                                                           00046
        CALL RIBDOT(N)                                                   00047
911     CALL DLPH(DLPTIM(II),N,72.,INDQ)                                 00048
        TOL=1.0E-06                                                      00049
        ISECT=1                                                          00050
        CALL DSKIN(BUF,ISECT,64)                                         00051
        DO 91 IEL=1,16                                                   00052
        ANGLR=(90.-DELPH(IEL))/RAD                                       00053
        COSANG(IEL)=COS(ANGLR)                                          00054
91      TANANG(IEL)=TAN(ANGLR)                                          00055
1       DO 20 I=1,272                                                    00056
        AL(I)=0.0                                                        00057
20      BL(I)=0.0                                                        00058
        IDSPLA=0                                                         00059
C                                                                        00060
```

```
      CALL BURST                                                  00061
      WRITE(13,4)                                                 00062
4     FORMAT('FREQ?(F7.3)')                                       00063
      READ(13,44) FREQ                                            00064
44    FORMAT(F7.3)                                                00065
      SPACE=18.288                                                00066
      XLAMDA=300.0/FREQ                                           00067
      SSPL=SPACE/XLAMDA*2.0*PI                                    00068
      SPEL=SSPL                                                   00069
      XK=SSPL/PI                                                  00070
      XU=2.0/XK-1.0                                               00071
      IF(XU.LE.0.0)GO TO 97                                       00072
      IF(XU.GT.1.0)XU=1.0                                         00073
      XANGL=ARSIN(XU)*RAD                                         00074
      GO TO 98                                                    00075
   97 XANGL=0.0                                                   00076
   98 CONTINUE                                                    00077
111   WRITE(13,6)                                                 00078
6     FORMAT(' TIME HR,MIN,SEC; NO OF ELEMENT  (3A2,I3)')         00079
      READ(13,113) IHR,IMIN,ISEC,MELEM                           00080
113   FORMAT(3A2,I3)                                              00081
      IF(MELEM.GT.16)GO TO 111                                    00082
  112 WRITE(13,8)                                                 00083
8     FORMAT(16HCONFIGURATION   X)                                00084
      READ(13,9)(MA(I),I=1,16)                                    00085
9     FORMAT(16I1)                                                00086
      DO 701 I=17,64                                              00087
701   MA(I)=0                                                     00088
      ISUM=0                                                      00089
      DO 71 I=1,64                                                00090
   71 ISUM=ISUM+MA(I)                                             00091
      IF(ISUM.EQ.MELEM)GO TO 711                                  00092
      WRITE(13,72)MA                                              00093
   72 FORMAT(64I1,/20X,19HCONFIGURATION ERROR)                   00094
      GO TO 112                                                   00095
  711 WRITE(13,10)                                                00096
10    FORMAT(' NGROUP,LOG BASE 2 OF NTIMES,STEER? (2I2,F7.3)')    00097
      READ(13,11) NGROUP,MTIMES,STEER                            00098
11    FORMAT(2I2,F7.3)                                            00099
      NTIMES=2**MTIMES                                            00100
      NGROUP=MIN0(NGROUP,NTIMES/16)                              00101
      MELEM2=2*MELEM                                              00102
1167  IFILE=1                                                     00103
      CALL RDTP(IFILE)                                            00104
      CALL TMASCI(STIME)                                          00105
      IF(STIME(4).NE.IHR.OR.STIME(5).NE.IMIN.OR.STIME(6)         00106
     1 .NE.ISEC) GO TO 1167                                       00107
      IFIRST=0                                                    00108
C                                                                 00109
166   CONTINUE                                                    00110
C                                                                 00111
C                                                                 00112
C     APPLY CORRECTION FACTORS                                   00113
C                                                                 00114
      ISECT=10                                                    00115
      DO 93 N=1,NGROUP                                            00116
      CALL RIBOOT(N)                                              00117
      IF(IFIRST.EQ.0) GO TO 1168                                  00118
      IFILE=+1                                                    00119
      CALL RDTP(IFILE)                                            00120
      CALL TMASCI(STIME)                                          00121
      IFIRST=1                                                    00122
```

```
      CALL DSKOUT(DUM,ISECT,523)                                       00123
      DO 93 NPULSE=1,16                                                 00124
      IWORD=32*(NPULSE-1)                                               00125
      DO 912 IEL=1,MELEM                                                00126
      I2=2*IEL                                                          00127
      IDNUM=I2+IWORD                                                    00128
      SAMPL(I2-1)=FLOAT(DUM(IDNUM-1))                                   00129
      SAMPL(I2)=FLOAT(DUM(IDNUM))*IQCORA(IEL)/COSANG(IEL)-SAMPL(I2-1)   00130
     1 *TANANG(IEL)                                                     00131
      ZSAMPL=CMPLX(SAMPL(I2-1),SAMPL(I2))*ZCORR(IEL)                    00132
      SAMPL(I2-1)=REAL(ZSAMPL)                                          00133
  912 SAMPL(I2)=AIMAG(ZSAMPL)                                           00134
      DO 931 K=1,MELEM2                                                 00135
  931 DUMD(K)=SAMPL(K)                                                  00136
C                                                                       00137
C     GENERATE THE COVARIANCE MATRIX                                    00138
C                                                                       00139
   93 CALL ADCRMT                                                       00140
C                                                                       00141
C                                                                       00142
C                                                                       00143
C                                                                       00144
C     INVERT THE COVARIANCE MATRIX                                      00145
C                                                                       00146
      DO 94 I=1,272                                                     00147
   94 BL(I)=AL(I)                                                       00148
      CALL CHLKYA                                                       00149
      CALL INVTL                                                        00150
      CALL HINVL                                                        00151
C                                                                       00152
C     CHECK GOODNESS                                                    00153
C                                                                       00154
      CALL MULHM                                                        00155
      CALL PRPKE                                                        00156
20156 AMP=1.0                                                          00157
      UTHET=SIN(STEER/RAD)                                              00158
      POSD=UTHET                                                        00159
      CALL SGEN3                                                        00160
      DO 9666 K=1,MELEM2                                                00161
 9666 VS(K)=DUMD(K)                                                     00162
      CALL HXV                                                          00163
      CALL VSRXW                                                        00164
      MT=0                                                              00165
      DO 96 K=1,15                                                      00166
      IF(MA(K).EQ.1) GO TO 996                                          00167
      STWT(K)=(0.,0.)                                                   00168
      GO TO 96                                                          00169
  996 MT=MT+1                                                           00170
      K2=2*MT                                                           00171
      STWT(K)=CMPLX(WT(K2-1)/REPI,-WT(K2)/REPI)                         00172
   96 CONTINUE                                                          00173
      WRITE(13,997) STWT                                                00174
  997 FORMAT(/(4E15.7))                                                 00175
      NNT=NTIMES/16                                                     00176
      ISECT=10                                                          00177
 1120 DO 6000 ITIMES=1,NNT                                             00178
      CALL RIBDOT(ITIMES)                                               00179
      IF(ITIMES.GT.NGROUP) GO TO 20213                                  00180
      CALL DSKIN(INBUF,ISECT,523)                                      00181
      GO TO 20214                                                       00182
20213 IFILE=1                                                          00183
      CALL RDTP(IFILE)                                                  00184
20214 CALL IMAGET(ITIMES)
```

```
C                                                                  00186
C     APPLY ALL CORRECTION FACTORS TO NEW SAMPLES, ADD WEIGHTS AND 00187
C     STEER AND STORE                                              00188
C                                                                  00189
      ITT=(ITIMES-1)*32                                            00190
      DO 5995 IE=1,32                                              00191
      II=IE+ITT                                                    00192
5995  FFTD(II)=0.                                                  00193
      DO 6000 IEL=1,16                                             00194
      ICONST=2*IEL-1                                               00195
      DO 6001 I=1,16                                               00196
      IRXWD=ICONST+32*(I-1)                                        00197
      I2=2*I                                                       00198
      I2M=I2-1                                                     00199
      ISAMPL(I2M)=WBUF(IRXWD)                                      00200
      ISAMPL(I2)=WBUF(IRXWD+1)*IQCORA(IEL)/COSANG(IEL)-            00201
     1 ISAMPL(I2M)*TANANG(IEL)                                     00202
      ZSAMPL=CMPLX(ISAMPL(I2M),ISAMPL(I2))*ZCORR(IEL)*STNT(IEL)    00203
      II=I2+ITT                                                    00204
      FFTD(II-1)=REAL(ZSAMPL)+FFTD(II-1)                           00205
6001  FFTD(II)=AIMAG(ZSAMPL)+FFTD(II)                             00206
6000  CONTINUE                                                     00207
C  IF DESIRED, TIME SERIES MAY BE WRITTEN ON TAPE HERE             00208
C                                                                  00209
C     MULTIPLY TIME SERIES BY DOLPH WEIGHTS                        00210
      IP=IPT(MTIMES-3)                                             00211
      DO 6005  I=1,NTIMES                                          00212
      I2=2*I                                                       00213
      II=I+IP                                                      00214
      IF(I2.GT.NTIMES) II=NTIMES+1-I+IP                            00215
      FFTD(I2-1)=FFTD(I2-1)*DLPTIM(II)                             00216
6005  FFTD(I2)=FFTD(I2)*DLPTIM(II)                                00217
C                                                                  00218
C     TAKE FFT AND PLOT SPECTRUM                                   00219
      CALL FORT2(MTIMES,-1,FFTD,IFRRR)                             00220
502   CALL SSWTCH(2,IUP)                                           00221
      IF(IUP.EQ.1)GO TO 502                                        00222
      CALL BURST                                                   00223
      CALL TKPLOT(0,0,0)                                           00224
      YSTART=1.4                                                   00225
      XSTART=.5                                                    00226
      CALL AXIS(XSTART,YSTART,IDB,12,4.0,90.0,-90.0,20.0,1)        00227
      CALL PLOT(XSTART,YSTART-.07,3)                               00228
      DO 5021 I=1,8                                                00229
      CALL PLOT(XSTART,YSTART,2)                                   00230
      XSTART=XSTART+.75                                            00231
      CALL PLOT(XSTART,YSTART,2)                                   00232
      CALL PLOT(XSTART,YSTART-.07,2)                               00233
5021  CONTINUE                                                     00234
      NSTR=NTIMES/2                                                00235
      NSTP=NSTR/4                                                  00236
      XSTART=XSTART-.1                                             00237
      YSTART=1.2                                                   00238
      DO 5022 I=1,9                                                00239
      FN=NSTR+.1*ISIGN(1,NSTR)                                     00240
      CALL NUMBER(XSTART,YSTART,.1,FN,0.,-1)                       00241
      NSTR=NSTR-NSTP                                               00242
5022  XSTART=XSTART-.75                                            00243
      XSTART=.5                                                    00244
      YSTART=1.4                                                   00245
      NP2=NTIMES/2                                                 00246
      SCN=6./FLOAT(NTIMES)
```

```
      PEAK=0.                                                          00247
      DO 5023 I=1,NTIMES                                               00248
      J=2*I                                                            00249
      FFTD(I)=FFTD(J-1)**2+FFTD(J)**2                                  00250
5023  PEAK=AMAX1(PEAK,FFTD(I))                                         00251
      SHFT=YSTART+4.-ALOG10(PEAK)*.5                                   00252
      DBMIN=1.E-8*PEAK                                                 00253
      IPEN=3                                                           00254
      X=XSTART                                                         00255
      DO 5024 I=1,NP2                                                  00256
      J=I+NP2                                                          00257
      Y=YSTART                                                         00258
      IF(FFTD(J).GT.DBMIN) Y=SHFT+ALOG10(FFTD(J))*.5                   00259
      CALL PLOT(X,Y,IPEN)                                             00260
      X=X+SCN                                                          00261
5024  IPEN=2                                                           00262
      NP2=NP2+1                                                        00263
      DO 5025 I=1,NP2                                                  00264
      Y=YSTART                                                         00265
      IF(FFTD(I).GT.DBMIN) Y=SHFT+ALOG10(FFTD(I))*.5                   00266
      CALL PLOT(X,Y,2)                                                00267
5025  X=X+SCN                                                          00268
      CALL PLOT(0.,.5,-1)                                             00269
      PKDB=10.*ALOG10(PEAK)                                            00270
      WRITE(13,102)(CTIME(I),I=1,5),ICOLON,CTIME(6),STEER,PKDB         00271
     1 ,(MA(I),I=1,16)                                                 00272
102   FORMAT(5X,'SAMPLE TIME   ',3A2,2X,2A2,A1,A2,3X,'STEER=',         00273
     1 F7.3,', PEAK=',F7.3,' DB'/5X,'USING ADAPTIVE WEIGHTS    '       00274
     2 '  CONFIGURATION=',16I1)                                        00275
      CALL TKWAIT                                                      00276
C                                                                     00277
C     SS2 UP = WAIT                                                   00278
C                                                                     00279
600   CALL SSWTCH(2,IUP)                                              00280
      IF(IUP.EQ.1)GO TO 600                                           00281
C     SS3 DOWN=GO ON,   UP= CHANGE ONLY STEER                         00282
C                                                                     00283
      CALL SSWTCH(3,IUP)                                              00284
      IF(IUP.NE.1) GO TO 630                                          00285
      CALL BURST                                                      00286
      WRITE(13,610)                                                   00287
610   FORMAT('STEER=?    (F7.3)')                                     00288
      READ(13,620) STEER                                              00289
620   FORMAT(F7.3)                                                    00290
      GO TO 20156                                                     00291
630   CONTINUE                                                        00292
C     SS1 DOWN=CONTINUE PROCESSING       UP=INPUT NEW TIME            00293
C     SS1 UP=CONTINUE PROCESSING                                      00294
C                                                                     00295
      CALL SSWTCH(1,IUP)                                              00296
      IF(IUP.EQ.1)GO TO 1                                             00297
      GO TO 166                                                       00298
SRADAPT    EQU   F.MAIN                                               00299
S          NTRY  RADAPT                                               00300
S          LIBR  RADAPT                                               00301
      END                                                             00302
```

APPENDIX F

EQUALIZATION FILTER DESIGN PROGRAM

```
      PROGRAM FILTRN                    96
      CALL FILTRIM
      END
      SUBROUTINE FILTRIM
*     NP=NUMBER OF POLES
*     NT=NUMBER OF TAPS
*     A(J,N)=N-TH COEFFICIENT IN J-TH BUTTERWORTH FILTER
*     SP(J,N)=N-TH POLE IN J-TH BUTTERWORTH FILTER
*     B=BANDWIDTH OF BUTTERWORTH FILTERS
*     TAU=TAP SPACING IN DELAY LINE
*     W(J,N)=N-TH TAP WEIGHT IN J-TH DELAY LINE
*     N1=COMPLEX REF CHANNEL
*     N2=CHANNEL TO BE MATCHED
*     NF=NUMBER OF FREQS
*     NS=NUMBER OF NORMALIZATION FREQ
*     IR=0 USES POLES
*     IR=1 INPUTS MEASURED FREQ
*     IS=1=1 AMP PER CHANNEL
*     IS=2=2 AMP PER CHANNEL
      COMPLEX A(2,10),SP(2,10),W(2,20),CP,C(20,20),C1(20,20),C2(20,20)
      COMPLEX XX,YY,SV(20),D(20,20)
      COMPLEX B1(101),B2(101),P(20),SS(101)
      COMPLEX CA,CB,CC,CD
      COMPLEX CPT
      COMMON/A/B1,B2,IXT,II,SS,IR,FV,CPT,IS
      DIMENSION FV(101)
      NAMELIST/INPUT/NP,NT,B,TAU,IT,IS,N1,N3,NF,NS,IR,IDUMP,N4
1     READ INPUT
      IF(NT.EQ.0) GO TO 900
      DO 100 N2=N3,N4,1
      II=2*NF
15    FORMAT(2I5,2F10.4)
      PI=4.*ATAN(1.)
      RAD=PI/180.
      CP=CMPLX(0.,PI)
      CPT=2.*CP*TAU
      WRITE(6,78)
78    FORMAT(1H1,//*       PROGRAM FOR EVALUATING FILTER MATCH*)
      WRITE(6,79)
79    FORMAT(1X,/*         FILTER COEFFICIENTS *)
      B=2.*PI*B
      IXT=0
*     SELECT TAP WEIGHTS FOR REFERENCE FILTER
*
      DO 50 J=1,NT
      W(1,J)=1.
      IF(J.NE.NT/2) W(1,J)=0.
50    CONTINUE
      IF(IR.EQ.1) CALL DATA(N1,N2,NS,NF,JF,RAD)
      IF(IR.EQ.1) GO TO 500
*
*     COMPUTE POLE LOCATIONS FOR BUTTERWORTH FILTERS
*
      UUU=RANF(3.)
      DO 10 N=1,NP
      SP(1,N)=B/2.*CEXP(CP*(.5+(2.*N-1)/2./NP))
      Y=RANF(0.)
      YY=CEXP(2.*CP*Y)
      X=RANF(0.)
10    SP(2,N)=SP(1,N)*(1.+.06*YY*(X-.5))
*
      COMPUTE COEFFICIENTS OF BUTTERWORTH FILTERS
```

```fortran
      DO 20 K=1,2
      DO 20 N=1,NP
      A(K,N)=1.
      DO 30 J=1,NP
      IF(J.EQ.N) GO TO 30
      A(K,N)=A(K,N)*1./(SP(K,N)-SP(K,J))
   30 CONTINUE
   20 A(K,N)=A(K,N)*(B/2.)**NP
C
C     PRINT PARAMETERS OF FILTERS
C
      DO 40 N=1,NP
   40 WRITE(6,41) SP(1,N),SP(2,N),A(1,N),A(2,N)
   41 FORMAT(8E15.6)
      WRITE(6,89) B,TAU
   89 FORMAT(///*   BANDWIDTH=*,F10.2,*    TIME DELAY=*,F10.4///)
C
C
C     COMPUTE COVARIANCE MATRIX OF TAP OUTPUTS
C
      DO 60 K=1,NT
      DO 60 L=1,NT
      C(K,L)=0.
      C1(K,L)=0.
      C2(K,L)=0.
      DO 61 M=1,NP
      DO 61 N=1,NP
      XX=CONJG(A(2,M))*A(2,N)/(CONJG(SP(2,M))+SP(2,N))
      YY=SP(2,N)*(K-L)
      IF(K.LT.L) YY=CONJG(SP(2,M))*(L-K)
      C(K,L)=C(K,L)-XX*CEXP(YY*TAU)
      XX=CONJG(A(2,M))*A(1,N)/(CONJG(SP(2,M))+SP(1,N))
      YY=SP(1,N)*(K-L)
      IF(K.LT.L) YY=CONJG(SP(2,M))*(L-K)
      C1(K,L)=C1(K,L)-XX*CEXP(YY*TAU)
      XX=CONJG(A(1,M))*A(1,N)/(CONJG(SP(1,M))+SP(1,N))
      YY=SP(1,N)*(K-L)
      IF(K.LT.L) YY=CONJG(SP(1,M))*(L-K)
      C2(K,L)=C2(K,L)-XX*CEXP(YY*TAU)
   61 CONTINUE
      D(K,L)=C(K,L)
   60 CONTINUE
      PRINT 200,((C(K,L),L=1,NT),K=1,NT)
      PRINT 200,((C1(K,L),L=1,NT),K=1,NT)
      PRINT 200,((C2(K,L),L=1,NT),K=1,NT)
  101 CONTINUE
C
C     INVERT COVARIANCE MATRIX M
C
      CALL MATINV(C,NT)
C
C     COMPUTE STEERING VECTOR
C
      DO 70 M=1,NT
      SV(M)=0.
      DO 71 N=1,NT
   71 SV(M)=SV(M)+C1(M,N)*W(1,N)
   70 CONTINUE
C
C     COMPUTE LMS TAP WEIGHTS
C
```

```
      DO 80 M=1,NT
      W(2,M)=0.
      DO 81 N=1,NT
   81 W(2,M)=W(2,M)+C(M,N)*SV(N)
   80 CONTINUE
*
*     PRINT THE FILTER WEIGHTS
*
      DO 82 J=1,NT
   82 WRITE(6,83) J,W(1,J),W(2,J)
   83 FORMAT(I5,4F15.5)
      WRITE(6,84)
   84 FORMAT(1X,//)
*
*     COMPUTE POWER IN OUTPUT
*
      YY=0.
      XX=0.
      DO 90 M=1,NT
      DO 90 N=1,NT
      XX=XX+CONJG(W(1,M))*C2(M,N)*W(1,N)
      XX=XX-W(2,M)*CONJG(C1(M,N)*W(1,N))
      YY=YY-CONJG(W(2,M))*C1(M,N)*W(1,N)
      YY=YY+CONJG(W(2,M))*D(M,N)*W(2,N)
   90 CONTINUE
      YY=YY+XX
      POUT=CABS(XX)
      PREF=CABS(YY)
*
*     PRINT FILTER RESPONSE
*
      E=H/2./PI
      CALL       FILFLT(SP,A,W,NP,NT,E,TAU,CP,NF,N1,N2)
*
  300 CONTINUE
*     COMPUT COVAR MAT USING FREQ
*
      IF(IXT.GE.1) GO TO 100
      IXT=IXT+1
      III=IM/2+1
      DO 62 K=1,NT
      DO 62 L=K,NT
      CA=CB=CC=CD=0.
      YY=CPT*(K-L)
      DO 63 I=1,II
      XX=CEXP(YY*FY(I))
      CA=CA+XX*CONJG(H2(I))*H2(I)
      CB=CB+XX*CONJG(H2(I))*H1(I)
      CC=CC+XX*CONJG(H1(I))*H1(I)
      CD=CD+CONJG(XX)*CONJG(H2(I))*H1(I)
   63 CONTINUE
      C(K,L)=CA
      D(K,L)=CA
      C1(K,L)=CB
      C2(K,L)=CC
      IF(K.EQ.L) GO TO 64
      C (L,K)=CONJG(CA)
      D(L,K)=C(L,K)
      C1(L,K)=CD
      C2(L,K)=CONJG(CC)
   64 CONTINUE
   62 CONTINUE
```

```
201      FORMAT(1X,2I2,10E11.3)
         IF(IDUMP.EQ.0) GO TO 101
         PRINT 200,(B1(I),I=1,11)
         PRINT 200,(B2(I),I=1,11)
         PRINT 200,((C(K,L),L=1,NT),K=1,NT)
         PRINT 200,((C1(K,L),L=1,NT),K=1,NT)
         PRINT 200,((C2(K,L),L=1,NT),K=1,NT)
200      FORMAT(1X, 8F11.3)
         GO TO 101
100      CONTINUE
         GO TO 1
900      CONTINUE
         RETURN
         END
         SUBROUTINE DATA(N1,N2,NS,NF,JF,RAD)
C        READ AND SELECT DATA
C        NC(1),NC(3) ARE ICOMP OF REC CHANNELS
C        NC(2),NC(4) ARE QCOMP OF REC CHANNELS
C        N1,N2 DESIGNATE REF AND OTHER CH
C        NF=NUMBER OF FREQOS
C        NS=SELECTED NORMALIZATION FREQ
         DIMENSION NC(4),DA(8,10),A(4,30),P(4,30),C(4,2)
         COMPLEX B1(101),B2(101)
         COMPLEX SS(101)
         COMMON/A/B1,B2,IX1,II,SS,IR,FY,CPT,IS
         COMPLEX CC
         COMPLEX CPT
         DIMENSION FY(101),FX(101)
C
         REWIND 9
         J1=IS*2
         JF=8
         NC(1)=N1*2-1
         NC(2)=N1*2
         NC(3)=N2*2-1
         NC(4)=N2*2
         IF(IS.EQ.1) NC(2)=N2
         IF(IS.EQ.1) NC(1)=N1
         DO 1 M=1,NF
         DO 2 K=1,JF
2        READ(9,8) KK,F,(DA(K,J),J=1,JF)
         AC=DA(1,1)
         PC=DA(5,1)
         FX(M)=F
         J2=JF/2
         DO 3 I=1,J1
         N=(NC(I)-1)/JF+1
         JJ=MOD(NC(I)-1,JF)+1
         A(I,M)=DA(N   ,JJ)
         P(I,M)=DA(N+J2,JJ)
         IF(N.EQ.1.AND.JJ.EQ.1) GO TO 7
         A(I,M)=A(I,M)+AC
         P(I,M)=P(1,M)+PC
7        CONTINUE
3        CONTINUE
1        CONTINUE
         DO 30 I=1,NF
         FY(I)=-FX(NF+1-I)
30       FY(NF+I)=FX(I)
         DO 6 I=1,J1
         C(I,1)=A(I,NS)
6        C(I,2)=P(I,NS)
```

```
C
      DO 4 J=1,NF
      DO 5 I=1,J1
      A(I,J)=A(I,J)-C(I,1)
      P(I,J)=P(I,J)-C(I,2)
      IF(II.EQ.2)P(I,J)=P(I,J)-90.
5     CONTINUE
20    FORMAT(/)
4     CONTINUE
      PRINT 20
      DO 10 M=1,NF
      DO 10 N=1,2
      AMP=10.**(A(N,M)/20.)
      AI=AMP          *COS(P(N,M)*RAD)
      L=N+1
      IF(IS.EQ.2) AU=10.**(A(L,M)/20.)*COS(P(L,M)*RAD)
      IF(IS.EQ.1) AU=AMP*SIN(P(N,M)*RAD)
      IF(N.EQ.2) GO TO 11
      CC=CMPLX(AI,AU)
      B1(NF+1-M)=CONJG(CC)
      B1(NF+M)=CC
      GO TO 10
11    CONTINUE
      CC=CMPLX(AI,AU)
      B2(NF+1-M)=CONJG(CC)
      B2(NF+M)=CC
10      CONTINUE
8     FORMAT(I1,F5.0,8F9.4)
9     FORMAT(1X,8F9.4)
21    FORMAT(1X,8E12.5)
      RETURN
      END
      SUBROUTINE FILPLT(SP,A,W,NP,NT,B,TAU,CP,NF,N1,N2)
*     B1=BUTTERWORTH FILTER, REFERENCE CHANNEL 1
*     B2=BUTTERWORTH FILTER,CHANNEL 2
*     C1=OVERALL CHANNEL 1 RESPONSE
*     C2=OVERALL CHANNEL 2 RESPONSE
      DIMENSION FY(101)
      COMMON/A/B1,B2,IXT,II,SS,IR,FY,CPT,IS
      COMPLEX CPT
      COMPLEX A(2,10),QP(2,10),W(2,20),B1(101),B2(101),C1(101),C2(101)
      COMPLEX SS(101)
      COMPLEX CP,S
      COMPLEX FRESP
      COMPLEX AAA
      R1=R2=R3=R4=RP1=RP2=0.
      AMPTOT1=AMPTOT2=0.
      III=II-1
      PRINT 900,N1,N2,NT
900   FORMAT(*   CORRECTION FILTER FOR RECEIVERS *,I2,* AND *,
     1I2,* WITH *,I2,* TAPS *)
      PRINT 901,TAU
901   FORMAT(*   FOR A TAP SPACING OF *,F9.4,* SECS. *)
      PRINT 902
902   FORMAT(* FREQ       PHASE        AMPLITUDE       TOTAL        FILTER
     1FILTER *)
      PRINT 903
903   FORMAT(*              ERROR         ERROR        MS ERROR      PHASE
     1 AMPL. *)
      PRINT 904
904   FORMAT(* (HZ)    (DEGREES)         (DB)        (DB POWER)  (DEGREES)
     1 (DB) *)
```

```
905     FORMAT(*        BEFORE AFTER  BEFORE AFTER  BEFORE AFTER *)
        PRINT 905
        DO 10 K=1,I1
        IF(IR.EQ.1) GO TO 1
        FREQ=H+2.*H*(K-1)/I11
        FY(K)=FREQ
        S=2.*CP*FREQ
        BS(K)=S
        B1(K)=B2(K)=0.
        DO 11 N=1,NP
        B1(K)=B1(K)+A(1,N)/(S-SP(1,N))
        B2(K)=B2(K)+A(2,N)/(S-SP(2,N))
     11 CONTINUE
        GO TO 2
     1  CONTINUE
        FREQ=FY(K)
     2  CONTINUE
        IF(FREQ.LE.0.) GO TO 10
        C1(K)=C2(K)=0.
        DO 12 N=1,NT
        C1(K)=C1(K)+CEXP(-CPT*FREQ*N)*W(1,N)
        C2(K)=C2(K)+CEXP(-CPT*FREQ*N)*W(2,N)
     12 CONTINUE
        C1(K)=C1(K)*B1(K)
        C2(K)=C2(K)*B2(K)
        R1=R1+CABS(B1(K)-B2(K))**2
        R2=R2+CABS(C1(K)-C2(K))**2
        R3=R3+CABS(B1(K))**2
        R4=R4+CABS(C1(K))**2
        A1=CABS(B1(K))
        A2=CABS(B2(K))
        AMPTOT1=(A2/A1-1.)**2+AMPTOT1
        A3=CABS(C1(K))
        A4=CABS(C2(K))
        AMPTOT2=(A4/A3-1.)**2+AMPTOT2
        P1=REAL(B1(K))
        IF(P1.EQ.0.)P1=1000000.
        P1=ATAN2(AIMAG(B1(K)),P1)
        P2=REAL(B2(K))
        IF(P2.EQ.0.)P2=1000000.
        P2=ATAN2(AIMAG(B2(K)),P2)
        P3=REAL(C1(K))
        IF(P3.EQ.0.)P3=1000000.
        P3=ATAN2(AIMAG(C1(K)),P3)
        P4=REAL(C2(K))
        IF(P4.EQ.0.)P4=1000000.
        P4=ATAN2(AIMAG(C2(K)),P4)
        R5=B/2.
        IF(FREQ.LT.-B5 .OR.FREQ.GT.B5 ) GO TO 30
        RP1=RP1+(P1-P2)**2
        RP2=RP2+(P3-P4)**2
     30 CONTINUE
        ADB1=20.*ALOG10(A2/A1)
        ADB2=20.*ALOG10(A4/A3)
        APH1=(P2-P1)*57.2958
        APH2=(P4-P3)*57.2958
        ATOT1=CABS(B2(K)-B1(K))
        IF(ATOT1.LE.1.E-10) ATOT1=1.E-10
        ATOT1=20.*ALOG10(ATOT1)
        ATOT2=CABS(C2(K)-C1(K))
        IF(ATOT2.LE.1.E-10) ATOT2=1.E-10
        ATOT2=20.*ALOG10(ATOT2)
```

```
      FRESP=0,
      EE=ALOG(10.)
      DO 950 KK=1,NT
      PI=3.14159265
      AA=-1.*FLOAT(KK-1)*2.*PI*FREQ*TAU
      AAA=CMPLX(COS(AA),SIN(AA))
950   FRESP=W(2,KK)*AAA+FRESP
      WT=2.*PI*FREQ*TAU
      FILPH=APH2-APH1
      FILAMP=CABS(FRESP)
      IF(FILAMP.LE.1.E-10) FILAMP=1.E-10
      FILAMP=20.*ALOG10(FILAMP)
      PRINT 906,FREQ,APH1,APH2,ADB1,ADB2,ATOT1,ATOT2,FILPH,FILAMP
906   FORMAT(1X,F5.1,6F7.2,2F9.2)
10    CONTINUE
      AMPTOT1=20.*ALOG10(SQRT(AMPTOT1/FLOAT(NF))+1.)
      AMPTOT2=20.*ALOG10(SQRT(AMPTOT2/FLOAT(NF))+1.)
      RA1=10.*ALOG10(R1/R3)
      RA2=10.*ALOG10(R2/R4)
      RP1=180./PI*SQRT(RP1/FLOAT(NF))
      RP2=180./PI*SQRT(RP2/FLOAT(NF))
      RRR=RA1-RA2
      PRINT 907,RP1,RP2,AMPTOT1,AMPTOT2,RA1,RA2
907   FORMAT(* TOTAL*,6F7.2)
      PRINT 908,RRR
908   FORMAT(* NET REDUCTION OF MISMATCH ERROR= *,F7.2,*DB.*)
      RETURN
      END
```

APPENDIX G
EQUALIZATION FILTER DESIGN RESULTS

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00460	-.00000
2	1.00000	0.00000	1.01249	.00000
3	0.00000	0.00000	-.00462	.00000
4	0.00000	0.00000	-.00394	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 2 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.42	-.33	-.13	-.12	-35.40	-36.76	.15	.01
20.0	-.68	-.49	-.13	-.11	-34.29	-36.44	.19	.02
25.0	-.79	-.58	-.12	-.08	-34.45	-37.47	.21	.04
30.0	-.86	-.64	-.11	-.06	-35.02	-38.61	.22	.05
35.0	-.89	-.67	-.09	-.02	-35.12	-38.90	.22	.07
40.0	-.81	-.60	-.07	.02	-35.89	-39.32	.20	.08
45.0	-.68	-.51	-.05	.05	-37.76	-39.43	.17	.10
50.0	-.63	-.50	-.02	.09	-39.62	-37.97	.13	.12
55.0	-.34	-.25	-.02	.11	-44.81	-37.76	.08	.13
60.0	0.00	.03	0.00	.14	-200.00	-35.74	.03	.14
65.0	.30	.27	-.01	.14	-45.32	-35.43	-.03	.15
70.0	.60	.52	-.04	.12	-39.44	-35.93	-.08	.16
75.0	.88	.75	-.07	.09	-35.73	-36.13	-.13	.16
80.0	1.16	.99	-.14	.03	-31.66	-35.00	-.17	.17
85.0	1.15	.95	-.22	-.05	-29.88	-35.04	-.20	.17
90.0	.91	.69	-.30	-.13	-29.28	-35.11	-.22	.17
95.0	.29	.07	-.33	-.17	-30.16	-36.18	-.22	.17
100.0	-.27	-.48	-.33	-.16	-30.73	-36.06	-.21	.17
105.0	-.81	-.99	-.26	-.10	-33.26	-37.29	-.19	.16
110.0	-.96	-1.11	-.17	-.01	-37.68	-40.05	-.15	.16
TOTAL	.45	.33	.16	.10	-33.32	-36.09		

NET REDUCTION OF MISMATCH ERROR= 2.77DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00973	.00000
2	1.00000	0.00000	1.01715	-.00000
3	0.00000	0.00000	-.01540	.00000
4	0.00000	0.00000	-.00102	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 3 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.10	-.42	-.07	-.13	-33.90	-33.37	.18	-.06
20.0	-1.19	-.46	-.07	-.12	-32.90	-33.26	.24	-.05
25.0	-1.28	-1.00	-.06	-.09	-32.75	-34.01	.28	-.03
30.0	-1.27	-.90	-.04	-.05	-34.11	-36.35	.32	-.01
35.0	-1.15	-.81	-.02	-.01	-34.27	-37.36	.34	.01
40.0	-1.01	-.66	-.01	.03	-34.98	-38.42	.36	.04
45.0	-.84	-.48	.00	.07	-36.69	-38.88	.36	.06
50.0	-.61	-.25	.01	.10	-40.14	-38.66	.36	.09
55.0	-.31	.04	.01	.13	-45.75	-37.07	.35	.12
60.0	0.00	.33	0.00	.15	-200.00	-34.82	.33	.15
65.0	.36	.67	-.03	.15	-43.09	-33.59	.31	.17
70.0	.70	.98	-.07	.13	-37.03	-33.39	.28	.20
75.0	.90	1.23	-.15	.08	-33.02	-33.17	.25	.22
80.0	1.07	1.29	-.24	.00	-29.46	-32.86	.22	.25
85.0	.85	1.03	-.35	-.09	-27.32	-33.66	.18	.27
90.0	.26	.42	-.46	-.17	-26.46	-34.39	.15	.29
95.0	-.69	-.57	-.50	-.20	-26.65	-33.99	.13	.30
100.0	-1.77	-1.68	-.47	-.16	-26.48	-31.53	.10	.32
105.0	-2.51	-2.43	-.36	-.04	-28.08	-30.96	.08	.33
110.0	-2.81	-2.76	-.23	.11	-31.01	-31.83	.05	.34
TOTAL	1.24	1.17	.23	.11	-30.39	-33.33		

NET REDUCTION OF MISMATCH ERRORS 2.94DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00244	-.00000
2	1.00000	0.00000	1.00468	.00000
3	0.00000	0.00000	-.00517	.00000
4	0.00000	0.00000	-.00142	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 4 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.28	-.17	.01	-.02	-46.41	-48.14	.11	-.03
20.0	-.36	-.22	-.00	-.02	-43.86	-46.44	.14	-.02
25.0	-.41	-.24	-.00	-.02	-43.01	-46.76	.17	-.02
30.0	-.43	-.24	-.01	-.02	-43.24	-47.55	.19	-.01
35.0	-.44	-.24	-.01	-.01	-42.67	-47.89	.20	.00
40.0	-.38	-.17	-.01	.01	-43.53	-50.22	.21	.01
45.0	-.30	-.10	-.01	.02	-45.58	-52.31	.20	.02
50.0	-.35	-.15	.00	.03	-45.08	-47.68	.20	.03
55.0	-.17	.02	-.00	.03	-51.19	-46.45	.18	.04
60.0	0.00	.17	0.00	.05	-200.00	-43.99	.17	.05
65.0	.13	.28	-.02	.04	-50.67	-43.32	.14	.06
70.0	.23	.35	-.04	.03	-45.22	-43.71	.12	.06
75.0	.28	.37	-.06	.01	-42.27	-44.05	.10	.07
80.0	.35	.42	-.10	-.02	-37.81	-42.06	.08	.08
85.0	.22	.27	-.13	-.05	-36.30	-42.74	.06	.08
90.0	-.04	-.00	-.16	-.07	-35.63	-42.38	.04	.08
95.0	-.49	-.46	-.14	-.06	-36.42	-41.47	.03	.09
100.0	-.73	-.71	-.11	-.02	-37.24	-40.14	.01	.09
105.0	-.93	-.92	-.04	.05	-39.05	-38.81	.01	.09
110.0	-.83	-.83	.04	.13	-42.26	-39.47	.00	.09
TOTAL	.43	.40	.07	.04	-40.03	-42.81		

NET REDUCTION OF MISMATCH ERROR= 2.78DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.01603	-.00000
2	1.00000	0.00000	1.01125	-.00000
3	0.00000	0.00000	-.02052	.00000
4	0.00000	0.00000	-.00335	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 5 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.06	-.85	.14	-.09	-32.38	-35.28	.22	-.23
20.0	-1.14	-.87	.12	-.08	-32.07	-34.89	.28	-.20
25.0	-1.13	-.81	.11	-.06	-32.61	-36.00	.32	-.17
30.0	-1.03	-.69	.10	-.04	-34.24	-38.72	.35	-.14
35.0	-.92	-.55	.09	-.02	-34.87	-40.60	.37	-.10
40.0	-.77	-.41	.07	.01	-35.89	-42.76	.36	-.06
45.0	-.61	-.25	.06	.04	-38.01	-44.04	.35	-.02
50.0	-.46	-.14	.04	.06	-41.24	-42.88	.32	.02
55.0	-.21	.08	.02	.09	-47.41	-40.41	.29	.06
60.0	0.00	.24	0.00	.11	-200.00	-37.74	.24	.11
65.0	.25	.45	-.04	.11	-44.46	-36.45	.20	.15
70.0	.49	.63	-.08	.10	-38.52	-36.22	.15	.18
75.0	.73	.82	-.14	.08	-34.49	-35.90	.10	.22
80.0	.80	.86	-.22	.03	-30.86	-36.11	.05	.25
85.0	.74	.76	-.51	-.03	-28.40	-37.17	.01	.28
90.0	.43	.41	-.40	-.10	-27.39	-37.99	-.02	.30
95.0	-.20	-.23	-.47	-.14	-27.30	-37.24	-.04	.32
100.0	-.98	-1.03	-.49	-.14	-27.05	-34.48	-.05	.34
105.0	-1.61	-1.69	-.45	-.09	-28.34	-33.67	-.05	.36
110.0	-2.01	-2.06	-.38	-.01	-31.01	-34.70	-.05	.37
TOTAL	.92	.84	.24	.08	-50.98	-36.17		

NET REDUCTION OF MISMATCH ERROR= 5.19DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.01461	.00000
2	1.00000	0.00000	1.01480	-.00000
3	0.00000	0.00000	-.02009	.00000
4	0.00000	0.00000	-.00493	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 6 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.67	-1.36	.04	-.14	-30.81	-31.16	.32	-.18
20.0	-1.59	-1.20	.04	-.12	-30.83	-32.00	.40	-.16
25.0	-1.48	-1.02	.04	-.09	-31.63	-33.92	.46	-.13
30.0	-1.37	-.87	.03	-.06	-33.13	-36.43	.50	-.09
35.0	-1.24	-.72	.04	-.02	-33.47	-38.31	.52	-.06
40.0	-1.04	-.52	.04	.02	-34.53	-40.47	.52	-.01
45.0	-.80	-.30	.03	.06	-36.81	-41.27	.50	.03
50.0	-.69	-.23	.03	.10	-38.75	-38.91	.46	.07
55.0	-.34	.07	.01	.12	-44.86	-37.38	.41	.11
60.0	0.00	.34	0.00	.15	-200.00	-34.64	.34	.15
65.0	.32	.59	-.04	.15	-42.93	-33.81	.27	.19
70.0	.60	.80	-.09	.13	-37.13	-34.14	.20	.22
75.0	.83	.96	-.15	.10	-33.45	-34.37	.13	.25
80.0	1.06	1.12	-.25	.03	-29.37	-33.91	.06	.28
85.0	.96	.97	-.35	-.05	-27.22	-34.87	.01	.30
90.0	.59	.56	-.46	-.14	-26.22	-35.29	-.03	.32
95.0	-.23	-.30	-.53	-.19	-26.35	-34.90	-.06	.34
100.0	-1.02	-1.10	-.54	-.19	-26.22	-33.03	-.08	.35
105.0	-1.86	-1.94	-.48	-.12	-27.63	-32.35	-.08	.36
110.0	-2.23	-2.30	-.39	-.02	-30.58	-33.73	-.07	.37
TOTAL	1.15	1.02	.25	.11	-29.91	-33.86		

NET REDUCTION OF MISMATCH ERROR= 3.95DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.01011	.00000
2	1.00000	0.00000	1.01651	-.00000
3	0.00000	0.00000	-.01498	-.00000
4	0.00000	0.00000	-.00078	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 7 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.85	-.72	-.05	-.11	-36.34	-35.30	.13	-.06
20.0	-.90	-.81	-.05	-.10	-34.75	-34.72	.17	-.05
25.0	-1.06	-.85	-.04	-.08	-34.49	-35.37	.21	-.03
30.0	-1.02	-.78	-.03	-.05	-35.70	-37.56	.24	-.02
35.0	-.99	-.74	-.02	-.01	-35.55	-38.17	.26	.01
40.0	-.91	-.63	-.01	.02	-35.95	-38.93	.27	.03
45.0	-.74	-.46	-.00	.05	-37.80	-39.86	.28	.05
50.0	-.55	-.26	.01	.09	-41.05	-39.78	.29	.08
55.0	-.29	-.00	.01	.11	-46.51	-38.13	.29	.11
60.0	0.00	.28	0.00	.14	-200.00	-35.67	.28	.14
65.0	.34	.61	-.05	.14	-43.54	-34.34	.27	.16
70.0	.67	.92	-.07	.12	-37.31	-34.03	.25	.19
75.0	.90	1.27	-.14	.07	-33.14	-33.36	.23	.21
80.0	1.04	1.25	-.24	.00	-29.71	-33.14	.21	.24
85.0	.79	.98	-.35	-.09	-27.52	-33.94	.19	.26
90.0	.20	.37	-.44	-.16	-26.69	-34.70	.16	.28
95.0	-.77	-.03	-.49	-.19	-26.83	-34.14	.14	.30
100.0	-1.81	-1.69	-.45	-.13	-26.78	-31.77	.12	.31
105.0	-2.60	-2.51	-.33	-.01	-28.24	-30.72	.09	.32
110.0	-2.86	-2.79	-.19	.14	-31.17	-31.53	.07	.33
TOTAL	1.20	1.15	.21	.10	-30.83	-33.84		

NET REDUCTION OF MISMATCH ERROR= 3.01DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00425	-.00000
2	1.00000	0.00000	1.00118	-.00000
3	0.00000	0.00000	.00356	.00000
4	0.00000	0.00000	-.00536	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 6 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.50	-.37	-.10	-.06	-36.68	-41.00	.22	.04
20.0	-.55	-.27	-.09	-.04	-37.01	-43.09	.28	.04
25.0	-.53	-.21	-.08	-.03	-38.00	-46.50	.31	.05
30.0	-.56	-.22	-.08	-.02	-38.53	-47.73	.33	.06
35.0	-.52	-.19	-.06	.00	-39.21	-50.00	.33	.06
40.0	-.43	-.12	-.05	.02	-40.53	-50.59	.31	.07
45.0	-.34	-.07	-.04	.03	-42.71	-48.80	.27	.07
50.0	-.37	-.15	-.02	.05	-44.04	-45.03	.22	.07
55.0	-.18	-.03	-.02	.05	-49.22	-45.43	.15	.07
60.0	0.00	.08	0.00	.06	-200.00	-42.95	.08	.06
65.0	.15	.15	-.00	.05	-51.70	-44.21	.00	.05
70.0	.25	.17	-.01	.03	-47.54	-46.83	-.07	.04
75.0	.33	.19	-.01	.02	-45.18	-49.14	-.14	.03
80.0	.43	.23	-.03	-.02	-41.69	-46.99	-.20	.01
85.0	.42	.18	-.03	-.04	-41.53	-45.18	-.25	-.01
90.0	.36	.09	-.04	-.06	-43.07	-43.64	-.27	-.02
95.0	.18	-.11	-.01	-.05	-51.75	-46.28	-.28	-.04
100.0	.24	-.03	.03	-.03	-47.29	-51.75	-.27	-.06
105.0	.27	.03	.06	.01	-43.15	-64.76	-.24	-.07
110.0	.56	.36	.13	.04	-40.88	-48.00	-.20	-.09
TOTAL	.40	.19	.06	.04	-40.79	-45.16		

NET REDUCTION OF MISMATCH ERROR= 4.36DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.01175	-.00000
2	1.00000	0.00000	1.01390	.00000
3	0.00000	0.00000	-.01246	-.00000
4	0.00000	0.00000	-.00240	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 9 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.55	-.44	-.01	-.10	-40.41	-37.55	.11	-.09
20.0	-.75	-.61	-.02	-.09	-37.42	-36.24	.14	-.07
25.0	-.85	-.69	-.02	-.08	-36.59	-36.66	.16	-.06
30.0	-.83	-.67	-.02	-.05	-37.52	-38.53	.17	-.03
35.0	-.81	-.65	-.01	-.02	-37.33	-39.16	.17	-.01
40.0	-.74	-.58	-.01	.01	-37.68	-39.72	.16	.02
45.0	-.63	-.48	-.00	.04	-39.30	-40.18	.14	.04
50.0	-.48	-.36	.00	.08	-42.23	-40.07	.12	.07
55.0	-.24	-.15	.00	.10	-48.18	-38.69	.09	.10
60.0	0.00	.06	0.00	.13	-200.00	-36.60	.06	.13
65.0	.32	.34	-.02	.13	-44.55	-35.49	.02	.15
70.0	.64	.65	-.06	.12	-38.33	-35.56	-.01	.18
75.0	.90	.95	-.11	.09	-34.05	-34.63	-.04	.20
80.0	1.13	1.06	-.19	.03	-30.56	-34.34	-.07	.22
85.0	1.07	.99	-.29	-.05	-28.48	-34.79	-.09	.24
90.0	.70	.60	-.38	-.13	-27.65	-35.60	-.10	.25
95.0	-.00	-.11	-.44	-.17	-27.87	-35.82	-.11	.27
100.0	-.84	-.94	-.44	-.16	-27.91	-34.35	-.10	.28
105.0	-1.52	-1.61	-.38	-.09	-29.58	-34.06	-.09	.29
110.0	-1.85	-1.93	-.29	.01	-32.66	-35.25	-.08	.30
TOTAL	.87	.83	.20	.10	-32.04	-35.55		

NET REDUCTION OF MISMATCH ERROR=   3.51DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00004	-.00000
2	1.00000	0.00000	1.00670	.00000
3	0.00000	0.00000	.00143	-.00000
4	0.00000	0.00000	-.00545	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 10 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.60	-.40	-.15	-.10	-34.87	-37.58	.20	.03
20.0	-.65	-.41	-.13	-.08	-34.62	-38.33	.25	.04
25.0	-.67	-.39	-.11	-.06	-35.39	-40.50	.28	.05
30.0	-.71	-.43	-.11	-.04	-36.02	-41.82	.28	.06
35.0	-.71	-.44	-.09	-.01	-36.34	-42.55	.27	.08
40.0	-.62	-.38	-.07	.02	-37.42	-43.04	.24	.09
45.0	-.50	-.31	-.05	.04	-39.57	-42.81	.19	.10
50.0	-.49	-.37	-.03	.07	-41.44	-40.13	.12	.10
55.0	-.24	-.19	-.02	.09	-46.85	-40.18	.05	.11
60.0	0.00	-.04	0.00	.11	-200.00	-37.92	-.04	.11
65.0	.23	.11	-.00	.10	-47.72	-38.2:	-.12	.11
70.0	.46	.26	-.01	.09	-42.21	-39.4:	-.20	.10
75.0	.68	.41	-.03	.07	-38.85	-39.98	-.27	.10
80.0	.94	.50	-.06	.02	-34.88	-39.19	-.33	.09
85.0	1.00	.62	-.10	-.03	-33.55	-38.62	-.37	.07
90.0	.94	.54	-.15	-.09	-33.31	-37.92	-.34	.06
95.0	.61	.22	-.16	-.12	-35.19	-38.94	-.39	.05
100.0	.42	.05	-.16	-.12	-36.51	-39.17	-.37	.03
105.0	.15	-.18	-.11	-.09	-41.17	-42.62	-.33	.02
110.0	.19	-.07	-.06	-.05	-48.46	-50.72	-.26	.01
TOTAL	.60	.36	.09	.08	-36.43	-39.15		

NET REDUCTION OF MISMATCH ERROR= 2.72DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00847	-.00000
2	1.00000	0.00000	1.00978	.00000
3	0.00000	0.00000	-.00955	-.00000
4	0.00000	0.00000	-.00226	.00000

CORRECTION FILTER FOR RECEIVERS   1 AND 11 WITH   4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.44	-.53	.00	-.07	-42.51	-40.32	.11	-.08
20.0	-.61	-.47	-.00	-.07	-39.37	-38.87	.14	-.06
25.0	-.68	-.52	-.01	-.06	-38.54	-39.13	.16	-.05
30.0	-.67	-.50	-.01	-.04	-39.43	-41.14	.17	-.03
35.0	-.67	-.49	-.00	-.01	-39.00	-41.55	.18	-.01
40.0	-.61	-.43	-.00	.01	-39.43	-42.21	.17	.01
45.0	-.51	-.35	.00	.03	-41.10	-42.81	.16	.03
50.0	-.37	-.24	.00	.06	-44.44	-42.93	.13	.05
55.0	-.19	-.08	.00	.08	-50.08	-41.59	.11	.07
60.0	0.00	.08	0.00	.09	-200.00	-39.19	.08	.09
65.0	.24	.30	-.02	.10	-46.22	-38.13	.05	.11
70.0	.50	.51	-.04	.09	-40.52	-37.78	.01	.13
75.0	.77	.75	-.09	.06	-38.24	-37.06	-.02	.15
80.0	.83	.79	-.14	.02	-33.08	-37.00	-.04	.16
85.0	.74	.67	-.22	-.04	-31.06	-37.88	-.06	.18
90.0	.44	.36	-.28	-.10	-30.28	-38.50	-.08	.19
95.0	-.11	-.19	-.32	-.13	-30.57	-38.41	-.08	.20
100.0	-.72	-.80	-.31	-.11	-30.70	-36.72	-.08	.20
105.0	-1.15	-1.22	-.26	-.05	-32.65	-36.71	-.08	.21
110.0	-1.30	-1.37	-.18	.03	-36.13	-38.14	-.06	.21
TOTAL	.66	.62	.15	.07	-34.64	-38.19		

NET REDUCTION OF MISMATCH ERROR   3.55DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00005	-.00000
2	1.00000	0.00000	1.00808	.00000
3	0.00000	0.00000	-.00742	-.00000
4	0.00000	0.00000	-.00306	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 12 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.18	-.07	.03	-.05	-47.15	-45.55	.11	-.07
20.0	-.36	-.25	.01	-.05	-43.66	-42.98	.13	-.06
25.0	-.45	-.31	.00	-.04	-42.11	-42.82	.15	-.05
30.0	-.51	-.36	-.01	-.04	-41.68	-42.85	.15	-.03
35.0	-.53	-.38	-.01	-.02	-41.05	-43.34	.15	-.01
40.0	-.47	-.54	-.01	-.00	-41.51	-44.40	.13	.01
45.0	-.40	-.50	-.01	.02	-42.90	-45.13	.10	.03
50.0	-.46	-.59	-.01	.04	-42.53	-42.08	.07	.05
55.0	-.23	-.19	-.01	.06	-48.74	-42.90	.03	.07
60.0	0.00	-.01	0.00	.09	-200.00	-39.87	-.01	.09
65.0	.21	.15	-.01	.09	-47.98	-39.38	-.06	.10
70.0	.42	.53	-.04	.08	-41.82	-39.65	-.10	.12
75.0	.50	.45	-.07	.06	-38.38	-39.70	-.13	.13
80.0	.82	.66	-.12	.02	-33.80	-38.55	-.16	.14
85.0	.84	.65	-.18	-.03	-31.92	-38.48	-.18	.15
90.0	.63	.43	-.24	-.08	-31.19	-38.86	-.20	.16
95.0	.15	-.04	-.27	-.11	-31.88	-39.77	-.20	.16
100.0	-.23	-.41	-.27	-.10	-32.39	-39.54	-.18	.17
105.0	-.63	-.77	-.22	-.05	-34.75	-40.06	-.16	.17
110.0	-.76	-.89	-.15	.02	-39.08	-41.86	-.13	.17
TOTAL	.50	.44	.13	.06	-36.11	-40.20		

NET REDUCTION OF MISMATCH ERROR= 4.09DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00260	.00000
2	1.00000	0.00000	1.00515	-.00000
3	0.00000	0.00000	-.00604	-.00000
4	0.00000	0.00000	-.00136	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 13 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.49	-.36	-.00	-.03	-41.62	-42.79	.13	-.03
20.0	-.54	-.38	-.00	-.03	-40.36	-42.37	.16	-.03
25.0	-.54	-.35	-.00	-.02	-40.51	-43.42	.19	-.02
30.0	-.51	-.30	-.00	-.01	-41.77	-45.99	.21	-.01
35.0	-.46	-.25	-.00	-.00	-41.82	-47.26	.23	-.00
40.0	-.42	-.20	-.00	.01	-42.37	-48.64	.24	.01
45.0	-.35	-.11	.00	.02	-44.30	-49.65	.24	.02
50.0	-.25	-.02	.00	.03	-47.81	-49.37	.25	.03
55.0	-.13	.09	.00	.04	-53.61	-46.02	.22	.04
60.0	0.00	.20	0.00	.05	-200.00	-43.16	.20	.05
65.0	.16	.34	-.01	.05	-49.94	-41.74	.18	.06
70.0	.20	.45	-.03	.04	-44.36	-41.54	.16	.07
75.0	.29	.43	-.07	.01	-41.42	-42.84	.14	.08
80.0	.38	.49	-.10	-.02	-37.19	-40.91	.12	.08
85.0	.29	.32	-.15	-.06	-35.22	-41.31	.09	.09
90.0	-.12	-.05	-.18	-.08	-34.60	-41.31	.07	.09
95.0	-.57	-.52	-.17	-.07	-35.11	-40.20	.06	.10
100.0	-.96	-.92	-.12	-.02	-35.42	-37.92	.04	.10
105.0	-1.19	-1.16	-.05	.06	-36.95	-36.95	.03	.10
110.0	-1.09	-1.07	.03	.14	-40.06	-37.92	.02	.11
TOTAL	.55	.51	.07	.05	-38.62	-41.03		

NET REDUCTION OF MISMATCH ERROR= 2.42DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.01159	.00000
2	1.00000	0.00000	1.01921	-.00000
3	0.00000	0.00000	-.01458	.00000
4	0.00000	0.00000	-.00029	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 14 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.28	-.21	-.08	-.12	-40.11	-36.95	.07	-.05
20.0	-.66	-.56	-.08	-.11	-36.65	-35.77	.10	-.03
25.0	-.87	-.75	-.07	-.08	-35.49	-35.85	.12	-.02
30.0	-1.01	-.88	-.06	-.06	-35.25	-36.31	.13	.00
35.0	-1.04	-.89	-.04	-.02	-34.97	-36.51	.15	.02
40.0	-.94	-.78	-.03	.02	-35.55	-37.20	.16	.05
45.0	-.78	-.61	-.02	.06	-37.33	-38.10	.17	.07
50.0	-.70	-.53	.00	.10	-38.97	-37.30	.17	.10
55.0	-.36	-.19	-.00	.12	-44.59	-37.19	.17	.13
60.0	0.00	.17	0.00	.15	-200.00	-34.84	.17	.15
65.0	.36	.52	-.03	.15	-42.92	-33.98	.17	.18
70.0	.68	.84	-.08	.13	-37.16	-33.90	.16	.21
75.0	.96	1.11	-.14	.09	-33.23	-33.64	.15	.24
80.0	1.18	1.32	-.24	.02	-29.17	-32.63	.14	.26
85.0	1.04	1.16	-.35	-.07	-27.06	-33.14	.13	.29
90.0	.55	.66	-.47	-.16	-26.08	-33.84	.11	.31
95.0	-.41	-.31	-.55	-.20	-26.33	-34.40	.10	.33
100.0	-1.33	-1.25	-.52	-.17	-26.32	-32.85	.08	.34
105.0	-2.21	-2.15	-.43	-.07	-27.84	-31.91	.07	.36
110.0	-2.56	-2.51	-.30	.07	-30.94	-32.79	.05	.37
TOTAL	1.08	1.05	.24	.11	-30.48	-33.89		

NET REDUCTION OF MISMATCH ERROR= 3.42DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00945	.00000
2	1.00000	0.00000	1.01944	-.00000
3	0.00000	0.00000	-.01134	-.00000
4	0.00000	0.00000	-.00195	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 15 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.53	-.41	-.14	-.15	-34.80	-34.67	.12	-.01
20.0	-.86	-.72	-.14	-.14	-33.15	-33.90	.15	.00
25.0	-1.06	-.89	-.12	-.10	-32.80	-34.24	.17	.02
30.0	-1.13	-.95	-.10	-.06	-33.69	-35.70	.19	.04
35.0	-1.13	-.94	-.08	-.02	-33.74	-36.04	.19	.06
40.0	-1.05	-.86	-.05	.03	-34.23	-36.21	.19	.08
45.0	-.89	-.71	-.03	.07	-36.05	-36.54	.18	.10
50.0	-.67	-.50	-.01	.11	-39.37	-36.73	.17	.13
55.0	-.35	-.20	-.00	.15	-44.94	-35.68	.15	.15
60.0	0.00	.12	0.00	.17	-200.00	-33.90	.12	.17
65.0	.41	.51	-.02	.17	-42.33	-33.09	.09	.19
70.0	.83	.90	-.06	.15	-36.27	-32.98	.06	.22
75.0	1.25	1.28	-.13	.10	-32.18	-32.41	.04	.24
80.0	1.39	1.41	-.23	.02	-28.92	-32.03	.01	.25
85.0	1.26	1.25	-.35	-.08	-26.90	-32.49	-.01	.27
90.0	.77	.74	-.46	-.18	-26.16	-33.12	-.03	.28
95.0	-.15	-.18	-.52	-.22	-26.52	-33.61	-.04	.29
100.0	-1.18	-1.22	-.50	-.20	-26.66	-32.40	-.04	.30
105.0	-2.01	-2.05	-.41	-.10	-28.36	-32.12	-.04	.31
110.0	-2.34	-2.37	-.28	.04	-31.59	-33.41	-.04	.32
TOTAL	1.11	1.07	.24	.13	-30.25	-33.12		

NET REDUCTION OF MISMATCH ERROR=   2.88DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00784	.00000
2	1.00000	0.00000	1.01637	.00000
3	0.00000	0.00000	-.00818	-.00000
4	0.00000	0.00000	-.00263	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 16 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.45	-.54	-.13	-.13	-35.85	-36.07	.11	-.00
20.0	-.60	-.56	-.12	-.12	-34.50	-35.59	.14	.01
25.0	-.83	-.68	-.11	-.09	-34.46	-36.32	.15	.02
30.0	-.91	-.75	-.10	-.06	-34.91	-37.32	.16	.04
35.0	-.93	-.77	-.08	-.02	-35.00	-37.06	.16	.06
40.0	-.86	-.71	-.06	.02	-35.58	-37.96	.15	.08
45.0	-.72	-.59	-.04	.06	-37.51	-38.40	.13	.10
50.0	-.67	-.56	-.02	.10	-39.28	-37.20	.11	.12
55.0	-.34	-.27	-.01	.12	-44.84	-37.03	.07	.14
60.0	0.00	.04	0.00	.15	-200.00	-34.90	.04	.15
65.0	.33	.33	-.02	.15	-44.17	-34.43	.00	.17
70.0	.68	.64	-.05	.14	-38.11	-34.61	-.04	.19
75.0	.97	.90	-.10	.10	-34.48	-34.58	-.07	.20
80.0	1.26	1.16	-.18	.03	-30.42	-33.58	-.10	.21
85.0	1.26	1.14	-.27	-.05	-28.38	-33.60	-.12	.22
90.0	.93	.60	-.37	-.14	-27.58	-34.08	-.13	.23
95.0	.18	.05	-.43	-.19	-28.05	-34.90	-.13	.24
100.0	-.56	-.69	-.43	-.19	-28.23	-34.30	-.13	.24
105.0	-1.30	-1.42	-.37	-.12	-30.09	-34.57	-.11	.25
110.0	-1.64	-1.73	-.26	-.01	-33.53	-36.19	-.09	.25
TOTAL	.87	.62	.21	.11	-31.77	-34.74		

NET REDUCTION OF MISMATCH ERROR=   2.97DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00450	.00000
2	1.00000	0.00000	1.00924	.00000
3	0.00000	0.00000	-.00732	.00000
4	0.00000	0.00000	-.00393	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 17 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.16	-.95	-.06	-.10	-33.74	-34.35	.21	-.04
20.0	-1.05	-.78	-.05	-.08	-34.16	-35.55	.27	-.03
25.0	-.96	-.65	-.05	-.06	-35.17	-37.62	.31	-.01
30.0	-.88	-.55	-.04	-.04	-36.72	-40.47	.34	.00
35.0	-.81	-.46	-.03	-.01	-37.17	-42.20	.34	.02
40.0	-.70	-.37	-.02	.02	-37.98	-43.47	.34	.04
45.0	-.58	-.26	-.01	.04	-39.88	-43.28	.32	.06
50.0	-.42	-.14	-.01	.07	-43.35	-42.35	.28	.08
55.0	-.22	.02	-.00	.09	-49.00	-40.10	.24	.09
60.0	0.00	.19	0.00	.11	-200.00	-37.83	.19	.11
65.0	.26	.39	-.01	.11	-46.37	-36.99	.13	.12
70.0	.52	.59	-.04	.09	-40.44	-37.02	.07	.13
75.0	.79	.81	-.08	.06	-36.24	-36.67	.02	.14
80.0	.83	.80	-.14	.01	-33.38	-36.98	-.03	.14
85.0	.73	.65	-.21	-.06	-31.41	-37.44	-.07	.15
90.0	.38	.28	-.27	-.12	-30.83	-37.61	-.10	.15
95.0	-.21	-.32	-.29	-.14	-31.45	-37.40	-.11	.15
100.0	-.83	-.95	-.26	-.11	-31.91	-35.94	-.12	.15
105.0	-1.27	-1.38	-.18	-.03	-33.97	-35.82	-.11	.15
110.0	-1.34	-1.43	-.09	.06	-37.77	-37.48	-.09	.15
TOTAL	.78	.71	.13	.08	-34.46	-36.98		

NET REDUCTION OF MISMATCH ERROR=   2.52DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00444	-.00000
2	1.00000	0.00000	1.00393	-.00000
3	0.00000	0.00000	-.00960	.00000
4	0.00000	0.00000	-.00321	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 18 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.11	-.87	.05	-.05	-34.07	-36.15	.24	-.10
20.0	-.96	-.66	.05	-.04	-34.86	-38.20	.30	-.09
25.0	-.81	-.46	.05	-.02	-36.33	-41.60	.35	-.07
30.0	-.74	-.35	.04	-.02	-38.11	-44.58	.39	-.06
35.0	-.64	-.23	.04	-.00	-38.84	-48.45	.41	-.04
40.0	-.49	-.07	.03	.01	-40.53	-53.86	.42	-.02
45.0	-.35	.06	.02	.02	-43.46	-50.61	.41	.00
50.0	-.34	.04	.02	.04	-44.39	-46.92	.39	.02
55.0	-.13	.22	.01	.04	-52.75	-44.44	.36	.04
60.0	0.00	.32	0.00	.05	-200.00	-41.57	.32	.05
65.0	.13	.40	-.03	.04	-48.55	-41.28	.27	.07
70.0	.22	.44	-.05	.03	-43.28	-42.03	.22	.08
75.0	.25	.42	-.08	.01	-40.41	-43.13	.17	.09
80.0	.26	.38	-.13	-.02	-36.36	-42.86	.12	.10
85.0	.11	.20	-.16	-.05	-34.72	-43.76	.08	.11
90.0	-.17	-.12	-.19	-.07	-34.05	-42.50	.05	.12
95.0	-.61	-.59	-.18	-.06	-34.67	-40.14	.02	.12
100.0	-.78	-.78	-.15	-.02	-35.46	-39.26	-.00	.12
105.0	-1.02	-1.03	-.09	.04	-37.33	-38.16	-.01	.13
110.0	-.93	-.94	-.02	.10	-41.51	-39.64	-.02	.13
TOTAL	.61	.52	.09	.04	-37.00	-40.66		

NET REDUCTION OF MISMATCH ERROR= 3.66DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00330	.00000
2	1.00000	0.00000	1.00663	-.00000
3	0.00000	0.00000	-.00667	-.00000
4	0.00000	0.00000	-.00231	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 19 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.61	-.45	-.02	-.06	-39.52	-40.19	.16	-.04
20.0	-.62	-.41	-.02	-.05	-39.00	-40.59	.21	-.03
25.0	-.63	-.39	-.02	-.04	-39.07	-42.02	.24	-.02
30.0	-.59	-.33	-.01	-.02	-40.49	-45.17	.26	-.01
35.0	-.60	-.32	-.01	-.00	-39.97	-45.41	.28	.01
40.0	-.53	-.25	.00	.02	-40.57	-46.04	.28	.02
45.0	-.45	-.17	.00	.04	-42.17	-45.46	.28	.03
50.0	-.37	-.11	.01	.05	-44.35	-44.32	.26	.05
55.0	-.16	.07	.01	.07	-51.05	-42.64	.24	.06
60.0	0.00	.21	0.00	.07	-200.00	-40.85	.21	.07
65.0	.19	.37	-.02	.06	-47.46	-40.42	.17	.08
70.0	.36	.50	-.05	.04	-41.74	-40.54	.14	.09
75.0	.50	.60	-.09	.01	-37.80	-40.10	.10	.10
80.0	.53	.60	-.14	-.04	-34.45	-38.85	.07	.11
85.0	.33	.37	-.20	-.08	-32.63	-38.57	.04	.11
90.0	-.01	.01	-.22	-.11	-32.61	-38.95	.02	.12
95.0	-.53	-.53	-.20	-.08	-34.06	-39.56	-.00	.12
100.0	-1.07	-1.09	-.14	-.02	-34.44	-36.57	-.01	.12
105.0	-1.21	-1.22	-.04	.08	-36.91	-36.08	-.02	.12
110.0	-1.12	-1.14	.04	.16	-39.71	-36.97	-.02	.12
TOTAL	.61	.57	.09	.07	-36.87	-39.35		

NET REDUCTION OF MISMATCH ERROR= 2.48DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.03350	.00000
2	1.00000	0.00000	1.01509	-.00000
3	0.00000	0.00000	-.05313	-.00000
4	0.00000	0.00000	-.00963	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 20 WITH 4 TAPS
FUR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-4.06	-3.21	.46	-.19	-21.07	-24.79	.85	-.65
20.0	-3.57	-2.49	.45	-.15	-21.51	-26.59	1.08	-.59
25.0	-3.11	-1.85	.43	-.09	-22.55	-29.50	1.26	-.52
30.0	-2.62	-1.23	.39	-.04	-24.55	-33.98	1.39	-.43
35.0	-2.20	-.73	.35	.01	-25.35	-38.20	1.46	-.34
40.0	-1.60	-.20	.30	.06	-26.68	-41.95	1.49	-.24
45.0	-1.23	.23	.25	.10	-29.22	-38.37	1.47	-.13
50.0	-.78	.62	.17	.14	-33.20	-35.06	1.40	-.03
55.0	-.38	.91	.09	.16	-39.04	-32.92	1.30	.07
60.0	0.00	1.17	0.00	.17	-200.00	-30.96	1.17	.17
65.0	.39	1.41	-.12	.14	-36.36	-30.53	1.02	.26
70.0	.61	1.46	-.25	.09	-30.87	-31.50	.87	.34
75.0	.67	1.38	-.39	.03	-27.40	-32.83	.71	.42
80.0	.67	1.23	-.55	-.06	-23.94	-32.84	.56	.49
85.0	.23	.65	-.70	-.15	-22.08	-33.71	.42	.55
90.0	-.59	-.29	-.82	-.21	-21.54	-32.62	.30	.60
95.0	-1.88	-1.67	-.85	-.20	-21.94	-30.48	.20	.65
100.0	-3.12	-2.99	-.79	-.11	-22.02	-27.62	.13	.69
105.0	-4.15	-4.08	-.65	.06	-23.50	-26.42	.07	.72
110.0	-4.66	-4.62	-.50	.24	-26.11	-27.07	.03	.74
TOTAL	2.34	2.03	.46	.13	-23.84	-29.43		

NET REDUCTION OF MISMATCH ERROR=   5.59DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.26440	.00000
2	1.00000	0.00000	.04134	-.00000
3	0.00000	0.00000	-.03503	.00000
4	0.00000	0.00000	-.00171	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 21 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	217.44	-119.10	-.35	-11.47	5.11	.9A	-336.56	-11.11
20.0	66.77	97.53	-.86	-11.83	.56	.67	30.76	-10.96
25.0	38.46	76.19	-.57	-11.37	-3.93	-.31	37.74	-10.80
30.0	-20.62	23.75	-.09	-10.73	-0.80	-5.41	44.37	-10.64
5.0	-69.11	341.56	-.36	-10.87	.52	-3.09	410.67	-10.50
40.0	-87.96	-31.27	-.83	-11.22	2.51	-2.13	56.69	-10.39
45.0	-237.62	184.85	-.69	-11.01	4.48	2.09	422.47	-10.31
50.0	244.41	-47.51	.33	-9.96	4.00	-2.46	-291.92	-10.29
55.0	-65.37	8.21	.03	-10.28	.11	-3.69	73.58	-10.31
60.0	0.00	79.03	0.00	-10.38	-200.00	-.10	79.03	-10.38
65.0	-265.36	179.15	-.62	-11.14	3.09	2.16	444.51	-10.52
70.0	215.25	-54.67	.08	-10.62	5.17	-1.74	-269.92	-10.71
75.0	-40.2	55.04	-.04	-10.99	-3.73	-1.79	95.83	-10.95
80.0	-68.35	33.48	-.59	-11.65	.84	-1.84	101.83	-11.26
85	-94.05	-57.78	-.63	-12.24	5.76	-.86	-251.83	-11.61
90.	84.85	-69.90	.20	-11.81	5.46	-1.16	114.95	-12.01
95.0	-27.76	94.50	.92	-11.52	-7.49	-1.32	122.26	-12.44
100.0	-68.34	61.66	1.89	-11.00	-.03	-3.05	130.20	-12.69
105.0	-254.65	-115.80	3.48	-9.85	2.50	-2.13	138.85	-13.33
110.0	-196.00	312.25	5.23	-8.50	3.14	-7.78	508.25	-13.73
TOTAL	15 .56	134.46	1.79	4.69	2.01	-.36		

NET REDUCTION OF MISMATCH ERROR= 3.270DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.01203	-.00000
2	1.00000	0.00000	1.01262	.00000
3	0.00000	0.00000	-.01648	-.00000
4	0.00000	0.00000	-.00202	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 22 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.86	-.68	.05	-.08	-36.12	-36.66	.18	-.13
20.0	-.95	-.72	.04	-.07	-35.10	-36.23	.22	-.12
25.0	-.95	-.69	.04	-.06	-35.33	-37.44	.26	-.10
30.0	-.92	-.63	.03	-.05	-36.54	-39.13	.29	-.07
35.0	-.86	-.58	.03	-.02	-36.34	-40.21	.31	-.04
40.0	-.75	-.43	.03	.01	-37.32	-42.24	.32	-.02
45.0	-.60	-.28	.02	.04	-39.45	-43.79	.32	.02
50.0	-.55	-.24	.02	.07	-40.82	-41.62	.31	.05
55.0	-.26	.03	.01	.09	-47.20	-40.66	.29	.08
60.0	0.00	.27	0.00	.11	-200.00	-37.29	.27	.11
65.0	.26	.49	-.05	.11	-44.49	-36.32	.24	.14
70.0	.48	.68	-.08	.09	-38.78	-36.37	.20	.17
75.0	.65	.82	-.13	.06	-35.03	-36.41	.17	.20
80.0	.80	.93	-.22	.01	-30.92	-35.64	.14	.22
85.0	.44	.75	-.30	-.05	-28.85	-36.73	.11	.25
90.0	.25	.33	-.39	-.12	-27.83	-37.20	.08	.27
95.0	-.52	-.46	-.43	-.14	-28.04	-36.67	.06	.28
100.0	-1.19	-1.15	-.41	-.11	-28.05	-34.61	.04	.30
105.0	-1.86	-1.84	-.35	-.03	-29.50	-33.56	.02	.31
110.0	-2.09	-2.08	-.25	.07	-32.63	-34.35	.01	.32
TOTAL	.92	.86	.20	.08	-32.02	-36.25		

NET REDUCTION OF MISMATCH ERROR=   4.23DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00097	-.00000
2	1.00000	0.00000	1.01083	.00000
3	0.00000	0.00000	.00007	-.00000
4	0.00000	0.00000	-.00437	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 23 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.47	-.32	-.18	-.17	-33.53	-36.99	.15	.06
20.0	-.64	-.46	-.17	-.10	-32.92	-36.83	.18	.07
25.0	-.74	-.54	-.15	-.08	-33.35	-37.86	.20	.08
30.0	-.78	-.58	-.13	-.05	-34.70	-39.74	.21	.09
35.0	-.80	-.60	-.11	-.01	-35.02	-39.95	.20	.10
40.0	-.74	-.56	-.08	.02	-35.83	-39.84	.17	.11
45.0	-.63	-.50	-.06	.06	-37.86	-39.38	.14	.11
50.0	-.48	-.39	-.04	.09	-41.32	-39.13	.09	.12
55.0	-.25	-.22	-.02	.11	-46.91	-38.04	.03	.13
60.0	0.00	-.03	0.00	.13	-200.00	-36.41	-.03	.13
65.0	.31	.27	-.00	.13	-45.18	-36.25	-.09	.13
70.0	.64	.49	-.02	.11	-39.36	-36.02	-.15	.13
75.0	.99	.79	-.05	.07	-35.35	-36.37	-.20	.13
80.0	1.11	.87	-.10	.02	-32.84	-36.19	-.24	.12
85.0	1.10	.82	-.17	-.05	-31.27	-36.01	-.27	.11
90.0	.85	.57	-.23	-.12	-31.20	-36.05	-.29	.11
95.0	.37	.08	-.25	-.15	-32.50	-36.89	-.29	.10
100.0	-.17	-.44	-.22	-.14	-33.98	-37.40	-.27	.09
105.0	-.54	-.78	-.16	-.08	-37.43	-39.37	-.24	.08
110.0	-.56	-.75	-.07	.00	-43.74	-43.46	-.19	.07
TOTAL	.67	.55	.13	.09	-34.38	-36.91		

NET REDUCTION OF MISMATCH ERROR= 2.54DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.01339	-.00000
2	1.00000	0.00000	1.02273	.00000
3	0.00000	0.00000	-.01609	-.00000
4	0.00000	0.00000	-.00264	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 24 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.89	-.73	-.12	-.17	-34.10	-32.87	.16	-.06
20.0	-1.13	-.92	-.11	-.15	-32.48	-32.41	.20	-.04
25.0	-1.26	-1.02	-.10	-.12	-32.25	-33.16	.24	-.02
30.0	-1.31	-1.06	-.09	-.08	-32.83	-34.53	.26	.01
35.0	-1.31	-1.04	-.07	-.03	-32.76	-35.06	.27	.04
40.0	-1.16	-.93	-.05	.02	-33.30	-35.64	.27	.07
45.0	-1.00	-.74	-.03	.07	-35.09	-36.23	.25	.10
50.0	-.88	-.64	-.01	.13	-37.04	-35.30	.23	.14
55.0	-.46	-.26	-.00	.16	-42.43	-34.70	.20	.17
60.0	0.00	.17	0.00	.20	-200.00	-32.51	.17	.20
65.0	.43	.56	-.03	.21	-41.79	-31.62	.13	.23
70.0	.90	1.00	-.06	.19	-35.35	-31.58	.09	.26
75.0	1.27	1.33	-.15	.14	-31.58	-31.58	.06	.29
80.0	1.61	1.63	-.27	.04	-27.50	-30.67	.02	.32
85.0	1.54	1.54	-.41	-.07	-25.34	-30.92	-.01	.34
90.0	.99	.96	-.56	-.20	-24.48	-31.67	-.03	.36
95.0	-.13	-.17	-.64	-.27	-24.73	-32.12	-.04	.37
100.0	-1.25	-1.30	-.64	-.25	-24.74	-30.44	-.05	.39
105.0	-2.32	-2.37	-.55	-.15	-26.31	-30.59	-.05	.40
110.0	-2.86	-2.91	-.41	.00	-29.31	-31.71	-.04	.41
TOTAL	1.31	1.25	.30	.15	-28.67	-31.78		

NET REDUCTION OF MISMATCH ERRORS 3.11DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00193	-.00000
2	1.00000	0.00000	1.00880	.00000
3	0.00000	0.00000	.00019	-.00000
4	0.00000	0.00000	-.00412	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 25 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.22	-.10	-.13	-.09	-36.76	-39.84	.12	.04
20.0	-.41	-.27	-.13	-.08	-35.75	-39.43	.14	.04
25.0	-.56	-.40	-.12	-.07	-35.66	-39.85	.15	.05
30.0	-.58	-.43	-.10	-.04	-36.96	-41.89	.15	.06
35.0	-.64	-.50	-.09	-.02	-36.87	-41.45	.14	.07
40.0	-.61	-.50	-.07	.01	-37.44	-41.07	.11	.08
45.0	-.53	-.46	-.05	.04	-39.27	-40.57	.07	.09
50.0	-.42	-.39	-.03	.07	-42.45	-40.40	.02	.10
55.0	-.22	-.26	-.01	.09	-48.08	-39.29	-.03	.11
60.0	0.00	-.09	0.00	.11	-200.00	-37.80	-.09	.11
65.0	.29	.14	-.00	.11	-46.01	-37.57	-.15	.11
70.0	.58	.38	-.01	.10	-40.26	-37.49	-.20	.11
75.0	.92	.66	-.04	.07	-36.17	-37.59	-.25	.11
80.0	1.06	.77	-.09	.02	-33.51	-37.17	-.29	.11
85.0	1.05	.74	-.14	-.04	-32.08	-37.02	-.31	.10
90.0	.85	.53	-.20	-.11	-32.01	-36.95	-.32	.09
95.0	.42	.10	-.22	-.14	-33.46	-37.94	-.32	.08
100.0	-.06	-.35	-.20	-.12	-35.19	-38.73	-.29	.08
105.0	-.38	-.04	-.13	-.06	-39.13	-41.10	-.26	.07
110.0	-.37	-.57	-.05	.01	-46.83	-45.76	-.20	.06
TOTAL	.58	.46	.11	.08	-35.82	-38.35		

NET REDUCTION OF MISMATCH ERROR=   2.54DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00070	.00000
2	1.00000	0.00000	1.00939	-.00000
3	0.00000	0.00000	-.00125	.00000
4	0.00000	0.00000	-.00259	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 20 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.65	-.51	-.15	-.09	-33.89	-37.44	.14	.06
20.0	-.66	-.49	-.14	-.07	-34.02	-38.30	.18	.07
25.0	-.65	-.45	-.12	-.05	-34.98	-40.26	.21	.07
30.0	-.70	-.48	-.11	-.04	-35.76	-41.30	.22	.08
35.0	-.70	-.47	-.09	-.01	-36.36	-42.06	.23	.08
40.0	-.63	-.41	-.07	.02	-37.34	-42.46	.23	.09
45.0	-.51	-.30	-.05	.04	-39.57	-42.84	.21	.09
50.0	-.47	-.28	-.02	.07	-41.93	-40.90	.19	.10
55.0	-.26	-.08	-.02	.09	-47.20	-40.62	.16	.10
60.0	0.00	.13	0.00	.10	-200.00	-38.32	.13	.10
65.0	.24	.33	-.01	.10	-47.23	-38.01	.09	.10
70.0	.43	.49	-.03	.08	-42.31	-38.63	.05	.10
75.0	.64	.66	-.05	.05	-38.58	-38.42	.02	.10
80.0	.77	.76	-.10	-.01	-34.80	-37.43	-.01	.10
85.0	.68	.64	-.15	-.06	-33.41	-37.57	-.04	.09
90.0	.37	.31	-.20	-.11	-33.06	-37.62	-.06	.09
95.0	-.23	-.50	-.20	-.12	-34.37	-38.45	-.07	.08
100.0	-.62	-.70	-.16	-.09	-35.47	-38.29	-.07	.08
105.0	-1.01	-1.08	-.08	-.01	-37.60	-38.00	-.07	.07
110.0	-1.00	-1.06	.02	.09	-40.92	-39.31	-.06	.07
TOTAL	.61	.56	.11	.07	-35.89	-38.32		

NET REDUCTION OF MISMATCH ERROR = 2.42DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00756	-.00000
2	1.00000	0.00000	1.00960	.00000
3	0.00000	0.00000	-.00802	-.00000
4	0.00000	0.00000	-.00349	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 27 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.62	-.46	-.02	-.09	-39.37	-38.11	.15	-.06
20.0	-.73	-.54	-.03	-.08	-37.55	-37.63	.19	-.05
25.0	-.78	-.57	-.03	-.06	-37.16	-38.57	.21	-.03
30.0	-.76	-.54	-.02	-.04	-38.17	-40.49	.23	-.02
35.0	-.73	-.50	-.02	-.01	-38.18	-41.35	.23	.00
40.0	-.65	-.07	-.01	.01	-38.73	-42.05	.21	.02
45.0	-.54	-.36	-.01	.04	-40.49	-42.23	.19	.05
50.0	-.40	-.24	-.00	.06	-43.91	-42.12	.15	.07
55.0	-.20	-.09	.00	.09	-49.50	-40.25	.11	.09
60.0	0.00	.06	0.00	.10	-200.00	-38.31	.06	.10
65.0	.29	.30	-.01	.11	-45.63	-37.53	.01	.12
70.0	.54	.51	-.04	.10	-40.13	-37.36	-.04	.14
75.0	.83	.75	-.06	.07	-35.86	-36.86	-.08	.15
80.0	.93	.81	-.14	.02	-32.81	-36.73	-.12	.16
85.0	.86	.71	-.21	-.04	-30.49	-37.53	-.15	.17
90.0	.58	.42	-.26	-.11	-30.24	-37.61	-.16	.17
95.0	.05	-.12	-.31	-.13	-30.83	-37.96	-.17	.18
100.0	-.55	-.71	-.30	-.12	-31.25	-36.88	-.16	.18
105.0	-1.01	-1.16	-.24	-.06	-33.31	-36.49	-.15	.18
110.0	-1.14	-1.26	-.16	.03	-37.27	-38.08	-.12	.18
TOTAL	.68	.01	.14	.08	-54.58	-37.70		

NET REDUCTION OF MISMATCH ERROR= 3.13DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.01004	-.00000
2	1.00000	0.00000	1.01224	.00000
3	0.00000	0.00000	-.01141	-.00000
4	0.00000	0.00000	-.00031	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 28 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.47	-.43	.01	-.06	-41.82	-40.24	.04	-.07
20.0	-.35	-.30	.02	-.04	-43.76	-42.86	.05	-.06
25.0	-.47	-.40	-.01	-.05	-41.77	-40.59	.06	-.05
30.0	-.60	-.52	-.02	-.05	-40.26	-40.11	.07	-.03
35.0	-.59	-.51	-.01	-.03	-40.11	-40.99	.08	-.01
40.0	-.45	-.37	.00	.01	-42.02	-43.62	.08	.01
45.0	-.40	-.32	-.00	.03	-43.14	-44.03	.08	.03
50.0	-.37	-.29	.00	.05	-44.42	-42.69	.08	.05
55.0	-.18	-.10	-.00	.07	-50.64	-41.90	.08	.07
60.0	0.00	.08	0.00	.10	-200.00	-38.95	.08	.10
65.0	.26	.33	-.05	.09	-44.96	-38.43	.08	.12
70.0	.50	.57	-.06	.08	-39.74	-37.59	.07	.14
75.0	.70	.76	-.10	.06	-36.03	-37.01	.06	.16
80.0	.76	.82	-.18	.00	-32.12	-36.78	.06	.19
85.0	.63	.68	-.26	-.05	-29.99	-37.39	.05	.20
90.0	.25	.29	-.33	-.11	-29.07	-37.92	.04	.22
95.0	-.45	-.42	-.37	-.13	-29.31	-37.54	.04	.24
100.0	-.84	-.81	-.34	-.09	-29.90	-37.39	.03	.25
105.0	-1.51	-1.49	-.27	-.01	-31.44	-35.26	.02	.26
110.0	-1.80	-1.78	-.19	.09	-34.28	-35.49	.02	.27
TOTAL	.71	.70	.17	.07	-33.84	-37.94		

NET REDUCTION OF MISMATCH ERROR=   4.09DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00426	.00000
2	1.00000	0.00000	1.01586	-.00000
3	0.00000	0.00000	-.00161	.00000
4	0.00000	0.00000	-.00542	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 29 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREG	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.50	-.43	-.23	-.17	-31.41	-33.86	.16	.06
20.0	-.81	-.62	-.21	-.15	-30.90	-33.89	.19	.07
25.0	-.93	-.73	-.19	-.11	-31.32	-34.93	.20	.08
30.0	-1.00	-.79	-.17	-.07	-32.66	-36.81	.20	.10
35.0	-1.03	-.84	-.14	-.02	-32.91	-36.91	.19	.11
40.0	-.96	-.81	-.10	.03	-33.72	-36.77	.15	.13
45.0	-.82	-.72	-.07	.07	-35.76	-36.42	.10	.14
50.0	-.73	-.70	-.04	.12	-37.99	-35.57	.04	.16
55.0	-.33	-.36	-.02	.15	-44.95	-35.04	-.03	.17
60.0	0.00	-.11	0.00	.18	-200.00	-33.57	-.11	.1?
65.0	.43	.25	-.00	.19	-42.36	-33.12	-.19	.19
70.0	.91	.66	-.02	.17	-36.33	-33.39	-.26	.19
75.0	1.24	.92	-.07	.12	-33.47	-33.65	-.32	.19
80.0	1.63	1.26	-.14	.05	-29.70	-32.73	-.37	.19
85.0	1.6A	1.28	-.23	-.05	-27.98	-32.61	-.40	.18
90.0	1.41	.99	-.33	-.16	-27.66	-32.80	-.41	.18
95.0	.77	.36	-.39	-.22	-28.47	-33.40	-.41	.17
100.0	.03	-.35	-.39	-.23	-29.25	-33.61	-.38	.16
105.0	-.64	-.97	-.33	-.17	-31.80	-35.30	-.33	.16
110.0	-.91	-1.17	-.23	-.08	-36.72	-38.87	-.26	.15
TOTAL	.95	.79	.20	.14	-31.24	-33.09		

NET REDUCTION OF MISMATCH ERROR=   2.45DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00926	.00000
2	1.00000	0.00000	1.01366	.00000
3	0.00000	0.00000	-.01169	-.00000
4	0.00000	0.00000	-.00528	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 30 WITH 4 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.02	-.76	-.05	-.14	-34.82	-34.06	.26	-.08
20.0	-1.13	-.80	-.05	-.12	-33.66	-34.19	.32	-.07
25.0	-1.14	-.77	-.04	-.09	-33.87	-35.71	.37	-.04
30.0	-1.18	-.78	-.04	-.06	-34.35	-37.24	.40	-.02
35.0	-1.12	-.72	-.03	-.01	-34.46	-38.54	.40	.01
40.0	-.99	-.60	-.01	.03	-35.18	-39.20	.39	.04
45.0	-.78	-.43	-.01	.06	-37.32	-39.61	.36	.07
50.0	-.65	-.35	.01	.11	-39.55	-37.96	.31	.10
55.0	-.34	-.10	.00	.13	-45.07	-37.10	.24	.13
60.0	0.00	.17	0.00	.15	-200.00	-34.97	.17	.15
65.0	.36	.46	-.03	.15	-42.99	-34.51	.10	.17
70.0	.67	.69	-.07	.12	-37.47	-35.01	.02	.19
75.0	.97	.92	-.13	.08	-33.63	-35.12	-.04	.21
80.0	1.18	1.07	-.21	.01	-29.90	-34.44	-.10	.22
85.0	1.11	.96	-.30	-.07	-28.00	-34.50	-.15	.23
90.0	.75	.56	-.39	-.15	-27.40	-34.66	-.18	.24
95.0	-.00	-.20	-.42	-.18	-28.23	-35.09	-.20	.25
100.0	-.65	-.85	-.40	-.15	-28.83	-35.02	-.20	.25
105.0	-1.30	-1.48	-.32	-.07	-31.00	-34.93	-.18	.25
110.0	-1.51	-1.66	-.21	.04	-34.81	-36.42	-.15	.25
TOTAL	.93	.82	.19	.11	-31.70	-34.95		

NET REDUCTION OF MISMATCH ERROR=   3.25DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.24821	.00000
2	1.00000	0.00000	.04488	-.00000
3	0.00000	0.00000	-.02846	.00000
4	0.00000	0.00000	.00537	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 31 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	218.54	-120.26	.19	-11.13	5.36	1.06	-338.80	-11.33
20.0	67.16	95.34	-.20	-11.49	.91	.62	28.18	-11.29
25.0	39.64	74.72	.01	-11.23	-3.43	-.38	35.08	-11.24
30.0	-18.64	23.22	.75	-10.44	-9.96	-3.53	41.86	-11.19
35.0	-66.71	341.78	.26	-10.87	.56	-3.09	408.50	-11.13
40.0	-87.24	-32.27	-.13	-11.21	2.??	-2.09	54.97	-11.08
45.0	-238.85	182.41	.00	-11.03	4.76	2.09	421.26	-11.03
50.0	244.41	-48.24	.61	-10.39	4.15	-2.35	-292.64	-11.00
55.0	-65.42	7.85	.56	-10.44	.40	-3.63	73.28	-11.00
60.0	0.00	79.04	0.00	-11.04	-200.00	-.12	79.04	-11.04
65.0	-265.22	179.46	-.01	-11.13	3.39	2.17	444.68	-11.12
70.0	215.34	-54.39	.52	-10.73	5.39	-1.75	-269.73	-11.25
75.0	-40.46	55.41	.60	-10.85	-3.44	-1.79	95.87	-11.45
80.0	-67.53	34.04	-.03	-11.74	1.01	-1.84	101.57	-11.71
85.0	194.21	-58.29	-.17	-12.21	5.99	-.84	-252.51	-12.04
90.0	-184.19	-70.42	.69	-11.75	5.71	-1.14	113.77	-12.44
95.0	-27.51	93.05	1.81	-11.10	-6.56	-1.33	120.56	-12.91
100.0	-68.10	59.94	2.16	-11.27	.12	-3.12	128.04	-13.43
105.0	-254.87	-118.45	3.69	-10.30	2.63	-2.12	136.42	-13.98
110.0	-194.80	311.05	5.84	-8.63	3.58	-7.57	505.85	-14.52
TOTAL	156.55	134.21	2.03	4.69	3.16	-.36		

NET REDUCTION OF MISMATCH ERROR= 3.52DB.

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PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00970	.00000
2	1.00000	0.00000	1.02050	-.00000
3	0.00000	0.00000	-.00922	.00000
4	0.00000	0.00000	-.00280	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 32 WITH 4 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREU (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.58	-.48	-.16	-.16	-33.77	-34.35	.10	.01
20.0	-.80	-.66	-.16	-.14	-32.75	-33.99	.12	.02
25.0	-.92	-.79	-.14	-.11	-32.89	-34.79	.14	.04
30.0	-1.05	-.91	-.13	-.08	-33.29	-35.59	.14	.05
35.0	-1.06	-.93	-.11	-.03	-33.49	-36.03	.14	.08
40.0	-.98	-.86	-.08	.02	-34.17	-36.59	.12	.10
45.0	-.83	-.74	-.06	.06	-35.97	-36.70	.10	.12
50.0	-.75	-.68	-.03	.11	-38.13	-35.70	.07	.14
55.0	-.39	-.36	-.02	.15	-43.58	-35.22	.03	.17
60.0	0.00	-.01	0.00	.19	-200.00	-33.19	-.01	.19
65.0	.44	.39	-.01	.19	-42.05	-32.52	-.05	.21
70.0	.86	.78	-.05	.18	-36.35	-32.62	-.08	.23
75.0	1.26	1.15	-.11	.13	-32.54	-32.46	-.12	.24
80.0	1.62	1.47	-.21	.05	-28.57	-31.49	-.14	.26
85.0	1.60	1.44	-.33	-.06	-26.56	-31.59	-.16	.26
90.0	1.19	1.02	-.46	-.18	-25.76	-32.01	-.17	.27
95.0	.23	.06	-.54	-.25	-26.22	-32.84	-.17	.28
100.0	-.74	-.90	-.54	-.24	-26.43	-32.25	-.16	.29
105.0	-1.70	-1.85	-.45	-.15	-28.21	-32.35	-.14	.30
110.0	-2.13	-2.24	-.32	-.02	-31.56	-33.96	-.12	.31
TOTAL	1.00	1.04	.25	.14	-29.97	-32.82		

NET REDUCTION OF MISMATCH ERROR= 2.85DB.

PROGRAM FUR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00353	-.00000
2	0.00000	0.00000	.01487	.00000
3	0.00000	0.00000	-.00659	-.00000
4	1.00000	0.00000	1.02045	.00000
5	0.00000	0.00000	-.00678	.00000
6	0.00000	0.00000	.00226	.00000
7	0.00000	0.00000	-.00223	-.00000
8	0.00000	0.00000	.00255	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 2 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.48	.14	-.13	.05	-35.40	-44.63	.63	.18
20.0	-.68	.11	-.13	.02	-34.29	-51.55	.79	.15
25.0	-.70	.11	-.12	-.01	-34.45	-54.16	.90	.11
30.0	-.86	.08	-.11	-.03	-35.02	-48.37	.95	.08
35.0	-.89	.03	-.09	-.04	-35.12	-47.40	.92	.05
40.0	-.81	.01	-.07	-.04	-35.89	-47.38	.81	.03
45.0	-.68	-.05	-.05	-.03	-37.76	-49.85	.63	.02
50.0	-.63	-.25	-.02	-.00	-39.62	-48.02	.39	.02
55.0	-.34	-.23	-.02	.01	-44.81	-47.99	.11	.03
60.0	0.00	-.17	0.00	.04	-200.00	-44.80	-.17	.04
65.0	.30	-.13	-.01	.05	-45.32	-44.27	-.43	.06
70.0	.60	-.02	-.04	.05	-39.44	-45.88	-.62	.08
75.0	.88	.15	-.07	.03	-35.73	-47.33	-.73	.11
80.0	1.16	.40	-.14	-.00	-31.60	-42.92	-.76	.14
85.0	1.15	.45	-.22	-.05	-29.88	-40.41	-.70	.17
90.0	.91	.32	-.30	-.09	-29.28	-39.46	-.59	.21
95.0	.29	-.15	-.33	-.08	-30.16	-41.99	-.44	.25
100.0	-.27	-.55	-.33	-.03	-30.73	-42.03	-.28	.30
105.0	-.81	-.96	-.26	.08	-33.26	-37.85	-.15	.34
110.0	-.96	-1.01	-.17	.21	-57.68	-36.09	-.05	.38
TOTAL	.45	.05	.16	.07	-33.32	-42.14		

NET REDUCTION OF MISMATCH ERROR=   8.82DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.01086	.00000
2	0.00000	0.00000	.01378	-.00000
3	0.00000	0.00000	-.00972	.00000
4	1.00000	0.00000	1.02477	-.00000
5	0.00000	0.00000	-.01712	.00000
6	0.00000	0.00000	.00598	-.00000
7	0.00000	0.00000	-.00612	.00000
8	0.00000	0.00000	.00427	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 3 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.10	-.02	-.07	.07	-33.90	-41.64	1.08	.14
20.0	-1.19	.13	-.07	.02	-32.96	-49.25	1.32	.09
25.0	-1.28	.17	-.06	-.02	-32.75	-49.40	1.45	.04
30.0	-1.22	.24	-.04	-.05	-34.11	-44.33	1.46	-.00
35.0	-1.15	.18	-.02	-.06	-34.27	-45.11	1.33	-.03
40.0	-1.01	.06	-.01	-.06	-34.98	-43.58	1.08	-.05
45.0	-.84	-.11	.00	-.04	-36.69	-46.50	.73	-.04
50.0	-.61	-.28	.01	-.01	-40.14	-46.78	.33	-.02
55.0	-.31	-.38	.01	.03	-45.75	-43.29	-.07	.02
60.0	0.00	-.41	0.00	.06	-200.00	-40.09	-.41	.06
65.0	.36	-.28	-.03	.08	-43.09	-39.86	-.64	.10
70.0	.70	-.02	-.07	.07	-37.03	-41.90	-.72	.15
75.0	.99	.24	-.15	.05	-33.02	-42.66	-.65	.19
80.0	1.07	.64	-.24	-.01	-29.46	-38.90	-.43	.23
85.0	.85	.74	-.35	-.07	-27.32	-36.13	-.11	.28
90.0	.26	.52	-.46	-.13	-26.46	-35.95	.26	.33
95.0	-.69	-.09	-.50	-.12	-26.65	-38.84	.60	.38
100.0	-1.77	-.92	-.47	-.04	-26.48	-37.66	.85	.43
105.0	-2.51	-1.54	-.36	.12	-28.08	-33.91	.96	.48
110.0	-2.81	-1.89	-.23	.50	-31.01	-32.10	.92	.53
TOTAL	1.24	.66	.23	.09	-30.39	-38.20		

NET REDUCTION OF MISMATCH ERROR=   7.81DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00479	-.00000
2	0.00000	0.00000	.00188	-.00000
3	0.00000	0.00000	-.00117	-.00000
4	1.00000	0.00000	1.00570	-.00000
5	0.00000	0.00008	-.00458	.00000
6	0.00000	0.00000	-.00001	-.00000
7	0.00000	0.00000	-.00115	.00000
8	0.00000	0.00000	.00120	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 4 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.88	.10	.01	.03	-46.41	-47.41	.38	.03
20.0	-.36	.10	-.00	.01	-43.86	-52.86	.46	.01
25.0	-.41	.09	-.00	-.00	-43.01	-55.35	.50	-.00
30.0	-.43	.07	-.01	-.03	-43.24	-50.47	.50	-.02
35.0	-.44	.01	-.01	-.03	-42.67	-49.86	.45	-.02
40.0	-.38	-.02	-.01	-.03	-43.53	-49.92	.36	-.02
45.0	-.30	-.06	-.01	-.02	-45.58	-52.08	.24	-.01
50.0	-.35	-.23	.00	-.00	-45.08	-48.59	.12	-.00
55.0	-.17	-.17	-.00	.01	-51.19	-50.24	-.01	.02
60.0	0.00	-.11	0.00	.03	-200.00	-47.15	-.11	.03
65.0	.13	-.04	-.02	.04	-50.67	-47.29	-.17	.05
70.0	.23	.05	-.04	.03	-45.22	-49.10	-.18	.07
75.0	.28	.13	-.06	.02	-42.27	-49.83	-.14	.08
80.0	.25	.9	-.10	-.01	-37.81	-45.69	-.06	.09
85.0	.22	.27	-.13	-.03	-36.30	-44.09	.06	.09
90.0	-.04	.14	-.16	-.06	-35.63	-43.34	.18	.10
95.0	-.49	-.19	-.14	-.05	-36.42	-45.53	.29	.10
100.0	-.73	-.36	-.11	-.01	-37.24	-46.09	.37	.10
105.0	-.93	-.53	-.04	.06	-39.05	-42.48	.40	.10
110.0	-.83	-.46	.04	.13	-42.26	-41.17	.37	.09
TOTAL	.43	.22	.07	.04	-40.03	-45.86		

NET REDUCTION OF MISMATCH ERROR=   5.83DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00566	.00000
2	0.00000	0.00000	.01135	-.00000
3	0.00000	0.00000	-.01863	-.00000
4	1.00000	0.00000	1.01762	-.00000
5	0.00000	0.00000	-.02352	.00000
6	0.00000	0.00000	.00277	-.00000
7	0.00000	0.00000	-.00641	.00000
8	0.00000	0.00000	.00249	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 5 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.06	-.13	.14	.04	-32.36	-45.88	.03	-.10
20.0	-1.14	-.02	.12	.01	-32.07	-57.80	1.13	-.11
25.0	-1.13	.09	.11	-.01	-32.61	-54.26	1.22	-.12
30.0	-1.03	.19	.10	-.02	-34.24	-48.29	1.21	-.12
35.0	-.92	.18	.09	-.03	-34.87	-46.68	1.10	-.12
40.0	-.77	.11	.07	-.03	-35.89	-48.06	.89	-.10
45.0	-.61	.00	.06	-.02	-38.01	-53.40	.61	-.08
50.0	-.46	-.17	.04	-.00	-41.24	-50.97	.29	-.05
55.0	-.21	-.24	.02	.01	-47.41	-47.56	-.03	-.01
60.0	0.00	-.30	0.00	.03	-200.00	-43.94	-.30	.03
65.0	.25	-.24	-.04	.04	-44.46	-44.16	-.49	.07
70.0	.49	-.09	-.08	.04	-38.52	-46.85	-.50	.12
75.0	.73	.17	-.14	.03	-34.49	-47.53	-.55	.17
80.0	.80	.36	-.22	.00	-30.86	-43.52	-.43	.22
85.0	.74	.52	-.31	-.04	-28.46	-39.69	-.22	.27
90.0	.43	.44	-.40	-.07	-27.39	-39.53	.01	.33
95.0	-.20	.05	-.47	-.08	-27.36	-43.02	.24	.39
100.0	-.98	-.56	-.49	-.03	-27.05	-41.78	.42	.46
105.0	-1.64	-1.13	-.45	.07	-26.34	-36.99	.51	.52
110.0	-2.01	-1.51	-.36	.19	-31.01	-35.07	.50	.57
TOTAL	.92	.49	.24	.06	-30.98	-41.85		

NET REDUCTION OF MISMATCH ERRORS 10.87DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00800	.00000
2	0.00000	0.00000	.01542	-.00000
3	0.00000	0.00000	-.01667	.00000
4	1.00000	0.00000	1.02287	-.00000
5	0.00000	0.00000	-.02326	.00000
6	0.00000	0.00000	.00250	-.00000
7	0.00000	0.00000	-.00706	.00000
8	0.00000	0.00000	.00208	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 6 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.67	-.36	.04	.04	-30.81	-42.35	1.31	-.00
20.0	-1.59	-.03	.04	.02	-30.83	-54.32	1.57	-.03
25.0	-1.48	.20	.04	-.00	-31.63	-48.97	1.69	-.05
30.0	-1.37	.29	.03	-.03	-33.13	-45.08	1.66	-.06
35.0	-1.24	.25	.04	-.03	-33.47	-45.11	1.49	-.07
40.0	-1.04	.16	.04	-.03	-34.53	-46.39	1.20	-.07
45.0	-.80	.02	.03	-.03	-36.81	-50.12	.82	-.06
50.0	-.69	-.29	.03	-.00	-38.75	-46.68	.40	-.04
55.0	-.34	-.34	.01	.01	-44.86	-44.85	-.00	-.00
60.0	0.00	-.35	0.00	.04	-200.00	-42.48	-.35	.04
65.0	.32	-.27	-.04	.05	-42.93	-42.88	-.59	.09
70.0	.60	-.10	-.09	.05	-37.13	-45.60	-.70	.14
75.0	.83	.15	-.15	.04	-33.45	-46.52	-.68	.19
80.0	1.06	.51	-.25	-.00	-29.37	-40.89	-.54	.25
85.0	.96	.64	-.35	-.04	-27.22	-38.20	-.32	.31
90.0	.59	.53	-.46	-.09	-26.22	-37.93	-.06	.37
95.0	-.23	-.04	-.53	-.09	-26.35	-41.49	.19	.44
100.0	-1.02	-.64	-.54	-.04	-26.22	-40.60	.39	.50
105.0	-1.86	-1.36	-.48	.08	-27.63	-35.38	.49	.56
110.0	-2.23	-1.73	-.39	.22	-30.58	-33.70	.50	.61
TOTAL	1.15	.59	.25	.07	-29.91	-40.15		

NET REDUCTION OF MISMATCH ERROR= 10.24DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.01023	-.00000
2	0.00000	0.00000	.01179	-.00000
3	0.00000	0.00000	-.00984	.00000
4	1.00000	0.00000	1.02328	-.00000
5	0.00000	0.00000	-.01642	-.00000
6	0.00000	0.00000	.00622	-.00000
7	0.00000	0.00000	-.00571	.00000
8	0.00000	0.00000	.00460	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 7 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.85	.06	-.05	.08	-36.34	-41.14	.91	.12
20.0	-.99	.13	-.05	.03	-34.75	-43.55	1.12	.07
25.0	-1.06	.18	-.04	-.02	-34.49	-48.50	1.24	.02
30.0	-1.02	.23	-.03	-.05	-35.70	-44.32	1.25	-.02
35.0	-.99	.15	-.02	-.06	-35.55	-42.64	1.15	-.04
40.0	-.91	.02	-.01	-.06	-35.95	-43.06	.93	-.05
45.0	-.74	-.12	-.00	-.04	-37.80	-46.01	.62	-.04
50.0	-.55	-.29	.01	-.01	-41.05	-46.49	.26	-.01
55.0	-.29	-.29	.01	.03	-46.51	-43.03	-.10	.02
60.0	0.00	-.41	0.00	.06	-200.00	-39.71	-.41	.06
65.0	.34	-.28	-.03	.08	-43.54	-39.45	-.62	.11
70.0	.67	-.02	-.07	.08	-37.31	-41.64	-.69	.15
75.0	.99	.38	-.14	.05	-33.14	-41.84	-.60	.19
80.0	1.04	.66	-.24	-.01	-29.71	-38.69	-.38	.23
85.0	.79	.74	-.35	-.06	-27.52	-35.94	-.06	.27
90.0	.20	.51	-.44	-.13	-26.69	-35.72	.31	.31
95.0	-.77	-.12	-.49	-.13	-26.83	-38.36	.65	.36
100.0	-1.81	-.91	-.45	-.04	-26.78	-37.82	.90	.41
105.0	-2.60	-1.59	-.33	.12	-28.24	-33.59	1.01	.46
110.0	-2.84	-1.90	-.19	.31	-31.17	-31.92	.95	.50
TOTAL	1.20	.67	.21	.10	-30.83	-37.94		

NET REDUCTION OF MISMATCH ERROR= 7.11DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00296	-.00000
2	0.00000	0.00000	.00341	-.00000
3	0.00000	0.00000	.00513	-.00000
4	1.00000	0.00000	1.00211	-.00000
5	0.00000	0.00000	.00451	.00000
6	0.00000	0.00000	-.00482	-.00000
7	0.00000	0.00000	.00109	.00000
8	0.00000	0.00000	-.00130	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 8 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES) BEFORE	AFTER	AMPLITUDE ERROR (DB) BEFORE	AFTER	TOTAL MS ERROR (DB POWER) BEFORE	AFTER	FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
15.0	-.59	-.07	-.10	.01	-36.68	-56.69	.52	.10
20.0	-.55	.06	-.09	.01	-37.01	-58.70	.60	.09
25.0	-.51	.11	-.08	.00	-38.00	-54.42	.63	.08
30.0	-.56	.05	-.08	-.01	-38.53	-58.33	.60	.07
35.0	-.52	.01	-.06	-.01	-39.21	-60.29	.53	.05
40.0	-.43	.00	-.05	-.01	-40.53	-54.27	.43	.04
45.0	-.34	-.03	-.04	-.01	-42.71	-57.49	.31	.03
50.0	-.37	-.18	-.02	-.00	-44.04	-50.93	.19	.02
55.0	-.18	-.11	-.02	-.00	-49.22	-55.20	.08	.02
60.0	0.00	-.03	0.00	.01	-200.00	-55.11	-.03	.01
65.0	.15	.03	-.00	.01	-51.70	-55.49	-.11	.02
70.0	.25	.06	-.01	.01	-47.54	-55.11	-.19	.02
75.0	.33	.08	-.01	.01	-45.18	-54.13	-.25	.02
80.0	.43	.13	-.03	-.00	-41.69	-52.84	-.30	.02
85.0	.42	.08	-.03	-.01	-41.53	-53.74	-.35	.02
90.0	.36	-.01	-.04	-.03	-43.07	-50.54	-.38	.01
95.0	.18	-.22	-.01	-.02	-51.75	-49.12	-.40	-.01
100.0	.24	-.15	.03	-.00	-47.29	-53.84	-.39	-.03
105.0	.27	-.09	.08	.02	-43.15	-53.56	-.36	-.06
110.0	.56	.25	.13	.04	-40.88	-49.19	-.31	-.08
TOTAL	.40	.11	.06	.02	-40.79	-52.91		

NET REDUCTION OF MISMATCH ERROR= 12.12DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00442	-.00000
2	0.00000	0.00000	.01340	.00000
3	0.00000	0.00000	-.01404	-.00000
4	1.00000	0.00000	1.02158	.00000
5	0.00000	0.00000	-.01545	-.00000
6	0.00000	0.00000	.00454	-.00000
7	0.00000	0.00000	-.00473	-.00000
8	0.00000	0.00000	.00309	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 9 WITH 8 TAPS FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.56	.11	-.01	.06	-40.61	-43.36	.66	.07
20.0	-.75	.07	-.02	.02	-37.42	-52.92	.82	.04
25.0	-.85	.09	-.02	-.01	-36.59	-53.27	.93	.01
30.0	-.83	.14	-.02	-.04	-37.52	-47.22	.97	-.02
35.0	-.81	.11	-.01	-.04	-37.13	-45.64	.92	-.03
40.0	-.74	.04	-.01	-.04	-37.68	-46.17	.79	-.04
45.0	-.63	-.06	-.00	-.03	-39.30	-49.75	.57	-.03
50.0	-.48	-.20	.00	-.01	-42.23	-49.87	.29	-.01
55.0	-.24	-.26	.00	.02	-48.18	-46.48	-.02	.02
60.0	0.00	-.31	0.00	.04	-200.00	-42.53	-.31	.04
65.0	.32	-.23	-.02	.06	-44.55	-42.20	-.55	.08
70.0	.64	-.06	-.06	.05	-38.33	-44.57	-.70	.11
75.0	.99	.25	-.11	.04	-34.05	-44.78	-.74	.14
80.0	1.13	.47	-.19	-.00	-30.66	-41.70	-.66	.18
85.0	1.07	.57	-.29	-.05	-28.48	-38.47	-.50	.23
90.0	.70	.42	-.38	-.10	-27.65	-38.09	-.28	.28
95.0	-.00	-.05	-.44	-.10	-27.87	-40.73	-.05	.34
100.0	-.84	-.69	-.44	-.03	-27.91	-40.16	.15	.41
105.0	-1.52	-1.23	-.38	.09	-29.58	-35.88	.29	.47
110.0	-1.85	-1.53	-.29	.24	-32.66	-33.96	.33	.53
TOTAL	.87	.52	.20	.07	-32.04	-40.59		

NET REDUCTION OF MISMATCH ERROR= 8.55DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00129	-.00000
2	0.00000	0.00000	.01143	.00000
3	0.00000	0.00000	-.00154	-.00000
4	1.00000	0.00000	1.01172	.00000
5	0.00000	0.00000	.00015	-.00000
6	0.00000	0.00000	-.00224	.00000
7	0.00000	0.00000	-.00037	-.00000
8	0.00000	0.00000	.00009	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 10 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.60	-.03	-.13	.02	-34.87	-54.40	.57	.15
20.0	-.65	.04	-.13	.01	-34.62	-58.70	.69	.13
25.0	-.67	.10	-.11	.00	-35.39	-55.12	.77	.11
30.0	-.71	.07	-.11	-.02	-36.02	-54.18	.78	.09
35.0	-.71	.03	-.09	-.02	-36.34	-54.65	.74	.07
40.0	-.62	.02	-.07	-.02	-37.42	-54.81	.64	.05
45.0	-.50	-.00	-.05	-.02	-39.57	-55.12	.49	.04
50.0	-.40	-.18	-.03	-.00	-41.44	-50.95	.32	.03
55.0	-.24	-.12	-.02	-.00	-44.85	-54.03	.12	.02
60.0	0.00	-.09	0.00	.02	-200.00	-50.72	-.04	.02
65.0	.23	-.06	-.00	.02	-47.72	-51.29	-.24	.03
70.0	.46	-.01	-.01	.02	-42.21	-53.02	-.47	.03
75.0	.68	.07	-.03	.02	-38.85	-51.68	-.61	.05
80.0	.94	.22	-.06	.00	-34.86	-48.18	-.71	.06
85.0	1.00	.22	-.10	-.02	-33.55	-47.06	-.78	.08
90.0	.94	.15	-.15	-.05	-33.31	-45.38	-.79	.10
95.0	.61	-.15	-.16	-.04	-35.19	-46.97	-.76	.12
100.0	.42	-.27	-.16	-.02	-36.51	-47.86	-.70	.14
105.0	.15	-.45	-.11	.04	-41.17	-44.28	-.60	.15
110.0	.10	-.28	-.06	.11	-48.48	-43.14	-.47	.17
TOTAL	.60	.17	.09	.03	-34.43	-48.30		

NET REDUCTION OF MISMATCH ERROR=   11.96DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00413	-.00000
2	0.00000	0.00000	.00952	.00000
3	0.00000	0.00000	-.00960	-.00000
4	1.00000	0.00000	1.01499	.00000
5	0.00000	0.00000	-.01133	-.00000
6	0.00000	0.00000	.00259	.00000
7	0.00000	0.00000	-.00345	-.00000
8	0.00000	0.00000	.00267	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 11 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.44	.10	.00	.05	-42.51	-45.19	.55	.04
20.0	-.61	.07	-.00	.01	-39.37	-53.91	.68	.02
25.0	-.68	.08	-.01	-.01	-38.54	-53.95	.76	-.00
30.0	-.67	.11	-.01	-.03	-39.43	-49.40	.78	-.02
35.0	-.67	.07	-.00	-.04	-39.06	-47.87	.74	-.03
40.0	-.61	.01	-.00	-.03	-39.43	-48.20	.62	-.03
45.0	-.51	-.07	.00	-.02	-41.10	-51.35	.44	-.02
50.0	-.37	-.15	.00	-.00	-44.44	-51.99	.22	-.01
55.0	-.19	-.21	.00	.02	-50.08	-48.36	-.02	.01
60.0	0.00	-.24	0.00	.04	-200.00	-44.63	-.24	.04
65.0	.26	-.16	-.02	.04	-46.22	-44.77	-.41	.06
70.0	.50	-.02	-.04	.04	-40.52	-46.39	-.51	.09
75.0	.77	.23	-.09	.03	-36.24	-46.29	-.53	.11
80.0	.83	.37	-.14	-.00	-33.08	-43.78	-.47	.14
85.0	.74	.40	-.22	-.04	-31.06	-41.16	-.33	.17
90.0	.44	.24	-.28	-.08	-30.28	-40.61	-.16	.21
95.0	-.11	-.08	-.32	-.07	-30.57	-43.02	.03	.25
100.0	-.72	-.54	-.31	-.02	-30.70	-42.32	.18	.29
105.0	-1.15	-.87	-.26	.07	-32.65	-38.67	.27	.33
110.0	-1.30	-1.00	-.18	.19	-36.13	-36.87	.30	.37
TOTAL	.66	.57	.15	.06	-34.64	-42.89		

NET REDUCTION OF MISMATCH ERROR= 8.24DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00117	-.00000
2	0.00000	0.00000	.00845	.00000
3	0.00000	0.00000	-.00976	-.00000
4	1.00000	0.00000	1.01256	.00000
5	0.00000	0.00000	-.00927	-.00000
6	0.00000	0.00000	.00077	.00000
7	0.00000	0.00000	-.00209	-.00000
8	0.00000	0.00000	.00187	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 12 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.18	.17	.03	.04	-47.15	-45.47	.35	.01
20.0	-.36	.09	.01	.01	-43.66	-53.72	.45	.00
25.0	-.45	.06	.00	-.01	-42.11	-57.28	.52	-.01
30.0	-.51	.04	-.01	-.03	-41.68	-50.09	.55	-.02
35.0	-.53	.02	-.01	-.03	-41.05	-49.22	.54	-.02
40.0	-.47	.01	-.01	-.03	-41.51	-49.53	.48	-.02
45.0	-.40	-.03	-.01	-.02	-42.90	-52.21	.37	-.01
50.0	-.46	-.24	-.01	-.00	-42.53	-48.28	.22	.00
55.0	-.22	-.16	-.01	.01	-48.74	-50.71	.05	.02
60.0	0.00	-.13	0.00	.04	-200.00	-46.43	-.13	.04
65.0	.21	-.09	-.01	.04	-47.98	-46.36	-.29	.05
70.0	.42	.01	-.04	.04	-41.82	-48.33	-.42	.07
75.0	.59	.10	-.07	.03	-38.38	-49.75	-.49	.09
80.0	.82	.31	-.12	-.01	-33.86	-45.13	-.51	.12
85.0	.84	.36	-.18	-.04	-31.92	-42.39	-.47	.14
90.0	.63	.24	-.24	-.07	-31.19	-41.73	-.39	.18
95.0	.15	-.14	-.27	-.06	-31.88	-44.01	-.29	.21
100.0	-.23	-.42	-.27	-.02	-32.39	-44.48	-.19	.25
105.0	-.63	-.73	-.22	.06	-34.75	-40.21	-.10	.29
110.0	-.76	-.79	-.15	.17	-39.08	-38.20	-.03	.32
TOTAL	.50	.30	.13	.05	-36.11	-44.23		

NET REDUCTION OF MISMATCH ERROR=   8.12DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00650	.00000
2	0.00000	0.00000	.00219	.00000
3	0.00000	0.00000	-.00104	.00000
4	1.00000	0.00000	1.00630	.00000
5	0.00000	0.00000	-.00538	-.00000
6	0.00000	0.00000	.00031	-.00000
7	0.00000	0.00000	-.00189	-.00000
8	0.00000	0.00000	.00116	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 13 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL DB ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.49	.03	-.00	.04	-41.62	-47.91	.52	.04
20.0	-.54	.08	-.00	.01	-40.36	-53.71	.62	.02
25.0	-.54	.11	-.00	-.01	-40.51	-53.32	.66	-.00
30.0	-.51	.12	-.00	-.02	-41.77	-50.55	.63	-.02
35.0	-.49	.06	-.00	-.03	-41.82	-49.18	.55	-.03
40.0	-.43	-.01	-.00	-.03	-42.37	-49.22	.42	-.03
45.0	-.35	-.09	.00	-.02	-44.30	-51.30	.26	-.02
50.0	-.25	-.17	.00	-.01	-47.81	-51.16	.09	-.01
55.0	-.13	-.19	.00	.01	-53.61	-49.17	-.07	.01
60.0	0.00	-.18	0.00	.03	-200.00	-46.19	-.16	.03
65.0	.16	-.08	-.01	.04	-49.99	-46.18	-.24	.05
70.0	.29	.05	-.03	.04	-44.38	-47.38	-.24	.07
75.0	.29	.13	-.07	.02	-41.42	-49.79	-.16	.09
80.0	.38	.34	-.10	-.01	-37.19	-44.46	-.04	.10
85.0	.22	.34	-.15	-.04	-35.22	-42.39	.12	.11
90.0	-.12	.16	-.18	-.07	-34.60	-42.61	.28	.11
95.0	-.57	-.14	-.17	-.06	-35.11	-44.85	.43	.11
100.0	-.96	-.44	-.12	-.01	-35.42	-44.29	.52	.11
105.0	-1.10	-.64	-.05	.06	-36.95	-41.10	.55	.11
110.0	-1.09	-.58	.03	.14	-40.06	-40.12	.50	.11
TOTAL	.55	.26	.07	.05	-38.62	-44.68		

NET REDUCTION OF MISMATCH ERROR=   6.27DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00685	.00000
2	0.00000	0.00000	.01559	-.00000
3	0.00000	0.00000	-.01317	.00000
4	1.00000	0.00000	1.02813	-.00000
5	0.00000	0.00000	-.01725	.00000
6	0.00000	0.00000	.00808	-.00000
7	0.00000	0.00000	-.00484	.00000
8	0.00000	0.00000	.00565	-.00000

CORRECTION FILTER FOR RECEIVERS   1 AND 14 WITH   8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.28	.37	-.08	.08	-40.11	-39.18	.65	.16
20.0	-.66	.19	-.08	.03	-36.65	-47.06	.84	.10
25.0	-.87	.12	-.07	-.02	-35.49	-51.27	.99	.05
30.0	-1.01	.05	-.06	-.06	-35.25	-44.46	1.06	.01
35.0	-1.04	.01	-.04	-.07	-34.97	-42.92	1.05	-.02
40.0	-.94	-.01	-.03	-.06	-35.55	-43.20	.92	-.03
45.0	-.78	-.08	-.02	-.04	-37.33	-46.40	.70	-.02
50.0	-.70	-.31	.00	-.00	-38.97	-46.01	.39	-.00
55.0	-.36	-.32	-.00	.03	-44.59	-44.42	.04	.03
60.0	0.00	-.29	0.00	.07	-200.00	-40.61	-.29	.07
65.0	.36	-.19	-.03	.08	-42.92	-40.31	-.55	.11
70.0	.68	-.03	-.08	.07	-37.16	-42.17	-.70	.15
75.0	.96	.24	-.14	.04	-33.23	-44.07	-.72	.19
80.0	1.18	.59	-.24	-.01	-29.17	-39.55	-.59	.23
85.0	1.04	.09	-.35	-.07	-27.06	-36.51	-.35	.28
90.0	.56	.52	-.47	-.13	-26.08	-35.72	-.04	.34
95.0	-.41	-.13	-.53	-.12	-26.33	-39.67	.27	.40
100.0	-1.33	-.60	-.52	-.04	-26.32	-38.76	.53	.47
105.0	-2.21	-1.55	-.43	.12	-27.84	-33.84	.67	.55
110.0	-2.56	-1.89	-.30	.32	-30.94	-31.83	.67	.61
TOTAL	1.08	.64	.24	.10	-30.48	-38.20		

NET REDUCTION OF MISMATCH ERROR=   7.72DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00731	-.00000
2	0.00000	0.00000	.01842	.00000
3	0.00000	0.00000	-.01151	.00000
4	1.00000	0.00000	1.02952	.00000
5	0.00000	0.00000	-.01422	-.00000
6	0.00000	0.00000	.00716	-.00000
7	0.00000	0.00000	-.00482	-.00000
8	0.00000	0.00000	.00533	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 15 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.53	.27	-.14	.08	-54.80	-39.96	.81	.22
20.0	-.86	.16	-.14	.03	-53.15	-47.75	1.02	.16
25.0	-1.06	.12	-.12	-.02	-52.80	-50.32	1.18	.10
30.0	-1.13	.11	-.10	-.05	-53.69	-45.35	1.25	.05
35.0	-1.13	.08	-.08	-.06	-53.74	-45.08	1.21	.01
40.0	-1.05	-.01	-.05	-.06	-54.23	-43.24	1.05	-.01
45.0	-.89	-.11	-.03	-.04	-56.05	-46.48	.78	-.01
50.0	-.67	-.25	-.01	-.01	-59.37	-47.93	.42	.01
55.0	-.35	-.32	-.00	.03	-44.94	-44.23	.02	.03
60.0	0.00	-.36	0.00	.06	-200.00	-40.38	-.36	.06
65.0	.41	-.25	-.02	.08	-42.33	-39.97	-.67	.10
70.0	.83	-.02	-.06	.07	-36.27	-41.94	-.86	.14
75.0	1.25	.35	-.13	.05	-32.18	-42.48	-.90	.18
80.0	1.30	.60	-.23	-.01	-28.92	-39.51	-.80	.22
85.0	1.26	.68	-.35	-.08	-26.90	-36.47	-.57	.27
90.0	.77	.49	-.46	-.13	-26.16	-35.84	-.27	.33
95.0	-.15	-.11	-.52	-.13	-26.52	-38.46	.04	.39
100.0	-1.18	-.87	-.50	-.04	-26.66	-38.15	.31	.46
105.0	-2.01	-1.53	-.41	.12	-28.36	-33.67	.48	.53
110.0	-2.34	-1.82	-.28	.31	-31.59	-32.00	.52	.60
TOTAL	1.11	.64	.24	.10	-30.25	-38.22		

NET REDUCTION OF MISMATCH ERROR= 7.97DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00380	.00000
2	0.00000	0.00000	.01701	-.00000
3	0.00000	0.00000	-.01053	.00000
4	1.00000	0.00000	1.02540	-.00000
5	0.00000	0.00000	-.01127	-.00000
6	0.00000	0.00000	.00510	.00000
7	0.00000	0.00000	-.00365	-.00000
8	0.00000	0.00000	.00388	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 16 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.45	.18	-.13	.06	-35.85	-42.91	.63	.19
20.0	-.03	.11	-.12	.02	-34.50	-50.32	.81	.14
25.0	-.83	.11	-.11	-.01	-34.46	-53.55	.94	.10
30.0	-.91	.09	-.10	-.04	-34.91	-46.79	1.00	-.06
35.0	-.93	.05	-.08	-.05	-35.00	-45.61	.99	.03
40.0	-.86	.01	-.06	-.05	-35.58	-45.67	.88	.02
45.0	-.72	-.04	-.04	-.03	-37.51	-48.82	.68	.01
50.0	-.67	-.27	-.02	-.00	-39.28	-47.40	.40	.02
55.0	-.34	-.26	-.01	.02	-44.84	-46.75	.08	.03
60.0	0.00	-.24	0.00	.05	-200.00	-42.92	-.24	.05
65.0	.33	-.18	-.02	.06	-44.17	-42.61	-.51	.07
70.0	.68	-.03	-.05	.05	-38.11	-44.60	-.71	.10
75.0	.97	.16	-.10	.04	-34.48	-46.21	-.81	.14
80.0	1.26	.46	-.18	-.01	-30.42	-41.76	-.80	.17
85.0	1.26	.58	-.27	-.05	-28.38	-38.48	-.68	.22
90.0	.93	.43	-.37	-.10	-27.56	-37.76	-.50	.27
95.0	.18	-.10	-.43	-.10	-28.03	-40.42	-.28	.33
100.0	-.56	-.65	-.43	-.04	-28.23	-40.53	-.08	.40
105.0	-1.30	-1.23	-.37	.09	-30.09	-35.84	.07	.46
110.0	-1.64	-1.49	-.26	.24	-33.53	-35.74	.15	.52
TOTAL	.87	.51	.21	.08	-31.77	-40.30		

NET REDUCTION OF MISMATCH ERROR= 8.53DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00691	.00000
2	0.00000	0.00000	.00944	-.00000
3	0.00000	0.00000	-.00454	.00000
4	1.00000	0.00000	1.01382	-.00000
5	0.00000	0.00000	-.00827	.00000
6	0.00000	0.00000	.00039	.00000
7	0.00000	0.00000	-.00372	.00000
8	0.00000	0.00000	.00119	.00000

CORRECTION FILTER FOR RECEIVERS   1 AND 17 WITH   8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.16	-.25	-.06	.04	-33.74	-44.57	.91	.09
20.0	-1.05	.03	-.05	.01	-34.16	-55.17	1.08	.07
25.0	-.96	.19	-.05	-.01	-35.17	-49.45	1.15	.04
30.0	-.88	.24	-.04	-.02	-36.72	-47.08	1.12	.02
35.0	-.81	.19	-.03	-.03	-37.17	-46.67	.99	.00
40.0	-.70	.08	-.02	-.03	-37.98	-48.08	.78	-.01
45.0	-.58	-.07	-.01	-.02	-39.88	-50.57	.51	-.01
50.0	-.42	-.21	-.01	-.01	-43.35	-49.19	.21	-.00
55.0	-.22	-.28	-.00	.01	-49.00	-46.37	-.07	.01
60.0	0.00	-.30	0.00	.03	-200.00	-43.70	-.30	.03
65.0	.26	-.20	-.01	.04	-46.37	-44.08	-.46	.06
70.0	.52	-.02	-.04	.05	-40.44	-46.03	-.54	.08
75.0	.79	.27	-.08	.03	-36.24	-45.18	-.52	.11
80.0	.83	.41	-.14	.00	-33.38	-42.84	-.42	.14
85.0	.73	.47	-.21	-.04	-31.41	-40.52	-.26	.16
90.0	.38	.30	-.27	-.08	-30.83	-40.20	-.08	.19
95.0	-.21	-.10	-.29	-.08	-31.45	-42.71	.10	.21
100.0	-.83	-.59	-.26	-.02	-31.91	-41.65	.24	.23
105.0	-1.27	-.95	-.18	.07	-33.97	-38.13	.32	.25
110.0	-1.34	-1.00	-.09	.18	-37.77	-36.92	.33	.27
TOTAL	.78	.40	.13	.06	-34.46	-42.30		

NET REDUCTION OF MISMATCH ERROR=   7.84DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00717	-.00000
2	0.00000	0.00000	.00208	.00000
3	0.00000	0.00000	-.00280	-.00000
4	1.00000	0.00000	1.00464	.00000
5	0.00000	0.00000	-.00893	.00000
6	0.00000	0.00000	-.00200	-.00000
7	0.00000	0.00000	-.00269	.00000
8	0.00000	0.00000	-.00039	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 18 WITH 8 TAPS
FOR A TAP SPACING OF   .0045 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.11	-.28	.05	.02	-34.07	-45.73	.83	-.04
20.0	-.96	-.00	.05	.01	-34.86	-59.57	.96	-.04
25.0	-.81	.18	.05	.00	-36.33	-50.35	.99	-.05
30.0	-.74	.18	.04	-.02	-38.11	-49.67	.92	-.05
35.0	-.64	.13	.04	-.02	-38.84	-50.78	.77	-.06
40.0	-.49	.08	.03	-.02	-40.53	-52.17	.57	-.05
45.0	-.35	-.02	.02	-.02	-43.46	-54.48	.34	-.04
50.0	-.34	-.22	.02	-.00	-44.39	-48.85	.12	-.02
55.0	-.13	-.19	.01	.00	-52.75	-49.88	-.06	-.00
60.0	0.00	-.18	0.00	.02	-200.00	-47.77	-.18	.02
65.0	.13	-.10	-.03	.02	-48.55	-49.67	-.23	.05
70.0	.22	.02	-.05	.02	-43.28	-51.90	-.20	.08
75.0	.25	.13	-.08	.02	-40.41	-50.19	-.11	.10
80.0	.26	.28	-.13	-.00	-36.38	-46.21	.02	.12
85.0	.11	.28	-.16	-.02	-34.72	-44.87	.17	.13
90.0	-.17	.15	-.19	-.04	-34.05	-45.41	.32	.14
95.0	-.61	-.17	-.18	-.03	-34.67	-47.79	.43	.14
100.0	-.78	-.28	-.15	-.01	-35.46	-48.02	.50	.14
105.0	-1.02	-.51	-.09	.04	-37.33	-43.46	.51	.13
110.0	-.93	-.48	-.02	.09	-41.51	-43.08	.45	.12
TOTAL	.61	.23	.09	.03	-57.00	-46.95		

NET REDUCTION OF MISMATCH ERROR= 9.95DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00802	.00000
2	0.00000	0.00000	.00313	-.00000
3	0.00000	0.00000	-.00087	.00000
4	1.00000	0.00000	1.00799	-.00000
5	0.00000	0.00000	-.00519	.00000
6	0.00000	0.00000	-.00046	-.00000
7	0.00000	0.00000	-.00088	.00000
8	0.00000	0.00000	.00122	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 19 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.61	.01	-.02	.05	-39.52	-45.52	.62	.06
20.0	-.62	.12	-.02	.01	-39.00	-51.41	.74	.04
25.0	-.63	.15	-.02	-.01	-39.07	-50.87	.78	.01
30.0	-.59	.17	-.01	-.03	-40.49	-48.04	.76	-.02
35.0	-.60	.07	-.01	-.04	-39.97	-46.73	.67	-.03
40.0	-.53	-.02	.00	-.04	-40.57	-47.45	.52	-.04
45.0	-.45	-.12	.00	-.02	-42.17	-49.02	.33	-.03
50.0	-.37	-.25	.01	-.01	-44.35	-47.83	.12	-.01
55.0	-.16	-.23	.01	.02	-51.05	-47.34	-.06	.01
60.0	0.00	-.21	0.00	.04	-200.00	-44.37	-.21	.04
65.0	.19	-.10	-.02	.05	-47.46	-44.47	-.29	.07
70.0	.36	.05	-.05	.05	-41.74	-45.73	-.31	.10
75.0	.50	.25	-.09	.03	-37.80	-46.04	-.25	.12
80.0	.53	.40	-.14	-.01	-34.45	-42.88	-.13	.13
85.0	.33	.36	-.20	-.05	-32.63	-40.89	.03	.14
90.0	-.01	.19	-.22	-.08	-32.61	-40.85	.21	.14
95.0	-.53	-.17	-.20	-.06	-34.06	-44.20	.36	.14
100.0	-1.07	-.60	-.14	-.01	-34.44	-41.66	.47	.13
105.0	-1.21	-.70	-.04	.08	-36.91	-39.78	.51	.12
110.0	-1.12	-.65	.04	.15	-39.71	-39.45	.48	.11
TOTAL	.61	.31	.09	.05	-36.87	-43.24		

NET REDUCTION OF MISMATCH ERROR= 6.37DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.02558	-.00000
2	0.00000	0.00000	.00701	.00000
3	0.00000	0.00000	-.02897	.00000
4	1.00000	0.00000	1.01877	-.00000
5	0.00000	0.00000	-.05229	-.00000
6	0.00000	0.00000	-.00330	-.00000
7	0.00000	0.00000	-.01178	.00000
8	0.00000	0.00000	-.00019	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 20 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-4.06	-1.08	.46	.05	-21.07	-34.43	2.98	-.42
20.0	-3.57	-.11	.45	.02	-21.51	-50.06	3.46	-.43
25.0	-3.11	.45	.43	-.00	-22.55	-42.16	3.56	-.43
30.0	-2.62	.70	.39	-.03	-24.55	-38.73	3.31	-.42
35.0	-2.20	.56	.35	-.05	-25.35	-39.40	2.76	-.40
40.0	-1.60	.31	.30	-.05	-26.68	-41.98	2.00	-.35
45.0	-1.23	-.07	.23	-.04	-29.22	-45.81	1.16	-.28
50.0	-.78	-.42	.17	-.01	-33.20	-43.25	.36	-.18
55.0	-.38	-.67	.09	.02	-39.04	-39.02	-.29	-.06
60.0	0.00	-.69	0.00	.06	-200.00	-36.98	-.69	.06
65.0	.30	-.44	-.12	.08	-36.36	-38.61	-.82	.19
70.0	.61	-.07	-.25	.07	-30.87	-41.83	-.68	.32
75.0	.67	.36	-.39	.05	-27.40	-42.03	-.31	.44
80.0	.67	.89	-.55	-.01	-23.94	-36.08	.22	.54
85.0	.23	1.04	-.70	-.08	-22.08	-33.87	.81	.63
90.0	-.50	.78	-.82	-.13	-21.54	-34.65	1.37	.69
95.0	-1.88	-.06	-.85	-.12	-21.94	-39.18	1.81	.73
100.0	-3.12	-1.05	-.79	-.04	-22.02	-36.65	2.07	.75
105.0	-4.15	-2.07	-.65	.11	-23.50	-31.83	2.08	.76
110.0	-4.66	-2.81	-.50	.27	-26.11	-30.43	1.84	.76
TOTAL	2.34	.99	.46	.09	-23.84	-35.98		

NET REDUCTION OF MISMATCH ERROR: 12.14DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.09515	.00000
2	0.00000	0.00000	-.06125	-.00000
3	0.00000	0.00000	.23299	.00000
4	1.00000	0.00000	.01362	-.00000
5	0.00000	0.00000	-.05957	.00000
6	0.00000	0.00000	-.02749	-.00000
7	0.00000	0.00000	-.00908	.00000
8	0.00000	0.00000	-.03857	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 21 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	217.45	-107.04	-.35	-22.53	5.11	-.05	-324.50	-22.17
20.0	66.77	92.42	-.86	-17.82	.56	.25	25.66	-16.96
25.0	38.46	61.47	-.57	-14.28	-3.93	-.76	23.02	-13.71
30.0	-20.62	3.10	-.09	-11.75	-9.80	-3.43	23.72	-11.66
35.0	-69.11	-42.10	-.36	-10.80	.52	-2.24	27.01	-10.43
40.0	-87.96	-55.09	-.83	-10.61	2.51	-1.20	32.87	-9.78
45.0	-237.62	165.76	-.69	-10.16	4.48	2.23	401.38	-9.47
50.0	244.41	-63.41	.33	-8.92	4.00	-1.66	-307.82	-9.25
55.0	-65.37	-1.32	.03	-8.91	.11	-4.43	64.05	-8.94
60.0	0.00	75.36	0.00	-8.52	-200.00	-.22	75.36	-8.52
65.0	-265.36	-180.32	-.62	-8.76	3.09	2.74	85.04	-8.14
70.0	215.24	-51.83	.08	-7.89	5.17	-2.25	-267.08	-7.47
75.0	-40.79	58.70	-.04	-8.20	-3.73	-1.84	99.49	-8.16
80.0	-68.35	37.20	-.54	-9.59	.84	-2.30	105.55	-8.79
85.0	194.05	-53.36	-.63	-10.53	5.76	-1.21	-247.91	-9.90
90.0	-184.85	-64.44	.20	-11.23	5.46	-1.42	120.41	-11.43
95.0	-27.76	-255.77	.92	-12.27	-7.49	-1.06	-228.01	-13.19
100.0	-68.34	78.97	1.89	-12.60	-.03	-2.31	147.31	-14.69
105.0	-254.65	268.73	3.48	-11.91	2.50	-3.22	523.38	-15.39
110.0	-196.00	-20.84	5.23	-10.11	3.14	-8.70	175.16	-15.34
TOTAL	156.56	113.25	1.73	-4.70	2.91	-.41		

NET REDUCTION OF MISMATCH ERRORS 3.32DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00706	-.00000
2	0.00000	0.00000	.00964	.00000
3	0.00000	0.00000	-.01258	-.00000
4	1.00000	0.00000	1.01802	.00000
5	0.00000	0.00000	-.01820	-.00000
6	0.00000	0.00000	.00342	.00000
7	0.00000	0.00000	-.00511	-.00000
8	0.00000	0.00000	.00287	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 22 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.86	-.03	.05	.05	-36.12	-44.06	.83	.00
20.0	-.95	.06	.04	.02	-35.10	-52.63	1.01	-.03
25.0	-.95	.15	.04	-.01	-35.33	-51.05	1.10	-.05
30.0	-.92	.18	.03	-.04	-36.54	-46.05	1.10	-.07
35.0	-.80	.11	.03	-.04	-36.39	-45.83	1.00	-.07
40.0	-.76	.06	.03	-.04	-37.32	-46.34	.81	-.07
45.0	-.60	-.04	.02	-.03	-39.45	-49.05	.56	-.05
50.0	-.55	-.28	.02	-.00	-40.82	-46.81	.26	-.02
55.0	-.26	-.29	.01	.02	-47.20	-45.85	-.03	.01
60.0	0.00	-.28	0.00	.05	-200.00	-42.66	-.28	.05
65.0	.26	-.19	-.03	.05	-44.49	-43.00	-.44	.09
70.0	.48	-.03	-.08	.05	-38.78	-45.20	-.51	.13
75.0	.65	.19	-.13	.03	-35.03	-46.44	-.46	.17
80.0	.80	.48	-.22	-.01	-30.92	-41.30	-.31	.21
85.0	.64	.55	-.30	-.05	-28.85	-38.87	-.09	.25
90.0	.25	.42	-.39	-.09	-27.83	-38.38	.17	.29
95.0	-.52	-.11	-.43	-.09	-28.04	-41.62	.41	.34
100.0	-1.10	-.60	-.41	-.03	-28.05	-41.30	.58	.38
105.0	-1.86	-1.20	-.35	.08	-29.50	-36.24	.67	.43
110.0	-2.00	-1.46	-.25	.22	-32.63	-34.53	.63	.47
TOTAL	.92	.50	.20	.07	-32.02	-40.81		

NET REDUCTION OF MISMATCH ERROR= 8.79DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00365	-.00000
2	0.00000	0.00000	.01342	.00000
3	0.00000	0.00000	-.00218	-.00000
4	1.00000	0.00000	1.01728	.00000
5	0.00000	0.00000	-.00130	-.00000
6	0.00000	0.00000	.00094	.00000
7	0.00000	0.00000	-.00127	-.00000
8	0.00000	0.00000	.00146	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 23 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.47	.13	-.18	.04	-33.53	-45.40	.60	.22
20.0	-.64	.17	-.17	.01	-32.92	-52.18	.74	.18
25.0	-.74	.10	-.15	-.01	-33.35	-53.83	.84	.14
30.0	-.78	.09	-.13	-.03	-34.70	-50.39	.87	.11
35.0	-.80	.04	-.11	-.03	-35.02	-48.29	.83	.07
40.0	-.74	-.02	-.06	-.03	-35.83	-47.45	.72	.05
45.0	-.63	-.09	-.05	-.02	-37.86	-50.22	.54	.03
50.0	-.48	-.17	-.04	-.01	-41.32	-51.02	.31	.03
55.0	-.25	-.20	-.02	.01	-46.91	-48.86	.05	.03
60.0	0.00	-.21	0.00	.04	-200.00	-45.00	-.21	.04
65.0	.31	-.13	-.04	.05	-45.18	-44.85	-.44	.05
70.0	.64	.02	-.02	.05	-39.36	-46.05	-.62	.06
75.0	.90	.26	-.05	.03	-35.35	-45.75	-.73	.08
80.0	1.11	.34	-.10	-.00	-32.84	-44.34	-.77	.10
85.0	1.10	.57	-.17	-.05	-31.27	-41.57	-.73	.12
90.0	.85	.22	-.23	-.08	-31.20	-40.77	-.64	.15
95.0	.37	-.14	-.25	-.08	-32.50	-42.71	-.51	.17
100.0	-.17	-.50	-.22	-.02	-33.48	-42.42	-.37	.20
105.0	-.54	-.78	-.16	.07	-37.43	-39.34	-.24	.23
110.0	-.56	-.69	-.07	.14	-45.79	-37.85	-.14	.26
TOTAL	.67	.31	.15	.06	-34.36	-43.26		

NET REDUCTION OF MISMATCH ERROR= 8.80DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00710	-.00000
2	0.00000	0.00000	.02218	.00000
3	0.00000	0.00000	-.01683	-.00000
4	1.00000	0.00000	1.03497	.00000
5	0.00000	0.00000	-.02054	-.00000
6	0.00000	0.00000	.00820	.00000
7	0.00000	0.00000	-.00671	-.00000
8	0.00000	0.00000	.00561	.00000

CORRECTION FILTER FOR RECEIVERS   1 AND 24 WITH   8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.89	.11	-.12	.08	-34.10	-40.54	1.00	.20
20.0	-1.13	.13	-.11	.03	-32.48	-47.69	1.26	.14
25.0	-1.26	.18	-.16	-.02	-32.25	-48.93	1.44	.08
30.0	-1.31	.20	-.09	-.06	-32.83	-43.53	1.51	.04
35.0	-1.31	.14	-.07	-.07	-32.76	-42.19	1.45	.00
40.0	-1.19	.06	-.05	-.06	-33.30	-42.69	1.25	-.01
45.0	-1.00	-.07	-.03	-.04	-35.09	-45.83	.93	-.01
50.0	-.88	-.56	-.01	-.00	-37.04	-44.70	.51	.00
55.0	-.46	-.41	-.00	.03	-42.43	-42.80	.06	.03
60.0	0.00	-.38	0.00	.07	-200.00	-39.72	-.38	.07
65.0	.43	-.30	-.23	.08	-41.79	-39.04	-.74	.11
70.0	.90	-.05	-.08	.08	-35.35	-41.21	-.96	.16
75.0	1.27	.26	-.15	.05	-31.56	-42.98	-1.01	.21
80.0	1.41	.70	-.27	-.01	-27.50	-38.11	-.91	.27
85.0	1.54	.88	-.41	-.08	-25.34	-34.87	-.67	.33
90.0	.90	.64	-.50	-.15	-24.48	-34.52	-.34	.41
95.0	-.13	-.13	-.64	-.14	-24.73	-37.32	-.00	.50
100.0	-1.25	-.96	-.64	-.05	-24.74	-37.15	.28	.59
105.0	-2.32	-1.85	-.55	.13	-26.31	-32.39	.47	.68
110.0	-2.86	-2.34	-.41	.36	-29.31	-30.34	.52	.77
TOTAL	1.31	.78	.30	.11	-28.67	-36.94		

NET REDUCTION OF MISMATCH ERROR=   8.26DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00207	-.00000
2	0.00000	0.00000	.01147	.00000
3	0.00000	0.00000	-.00330	-.00000
4	1.00000	0.00000	1.01440	.00000
5	0.00000	0.00000	-.00119	-.00000
6	0.00000	0.00000	.00045	.00000
7	0.00000	0.00000	-.00081	-.00000
8	0.00000	0.00000	.00196	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 25 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.22	.20	-.13	.04	-36.76	-44.77	.42	.17
20.0	-.41	.12	-.13	.01	-35.75	-51.75	.53	.14
25.0	-.56	.06	-.12	-.01	-35.66	-56.41	.61	.11
30.0	-.58	.07	-.10	-.02	-36.96	-51.06	.65	.08
35.0	-.64	.01	-.09	-.03	-36.87	-48.78	.64	.06
40.0	-.61	-.03	-.07	-.03	-37.44	-48.40	.57	.04
45.0	-.53	-.09	-.05	-.02	-39.27	-50.72	.44	.03
50.0	-.42	-.15	-.03	-.01	-42.45	-51.77	.26	.03
55.0	-.22	.17	-.01	.01	-48.08	-41.15	.05	.03
60.0	0.00	-.18	0.00	.03	-200.00	-46.00	-.18	.03
65.0	.29	-.10	-.00	.04	-46.01	-45.52	-.39	.04
70.0	.58	.02	-.01	.04	-40.22	-46.71	-.56	.05
75.0	.92	.23	-.04	.03	-36.17	-46.40	-.68	.07
80.0	1.06	.32	-.09	-.00	-33.51	-44.96	-.74	.08
85.0	1.05	.32	-.14	-.04	-32.08	-42.47	-.73	.10
90.0	.85	.19	-.20	-.08	-32.01	-41.35	-.67	.12
95.0	.42	-.14	-.22	-.07	-33.46	-43.19	-.56	.15
100.0	-.06	-.50	-.20	-.02	-35.19	-43.10	-.44	.18
105.0	-.38	-.70	-.13	.07	-39.13	-40.16	-.32	.20
110.0	-.37	-.58	-.05	.18	-46.83	-38.62	-.21	.23
TOTAL	.58	.28	.11	.05	-35.82	-43.92		

NET REDUCTION OF MISMATCH ERROR=   8.10DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00593	.00000
2	0.00000	0.00000	.00856	.00000
3	0.00000	0.00000	.00122	.00000
4	1.00000	0.00000	1.01343	-.00000
5	0.00000	0.00000	-.00137	.00000
6	0.00000	0.00000	.00113	.00000
7	0.00000	0.00000	-.00150	.00000
8	0.00000	0.00000	.00156	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 26 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES) BEFORE	AFTER	AMPLITUDE ERROR (DB) BEFORE	AFTER	TOTAL MS ERROR (DB POWER) BEFORE	AFTER	FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
15.0	-.65	-.02	-.15	.04	-33.89	-47.21	.63	.19
20.0	-.66	.10	-.14	.02	-34.02	-51.49	.76	.16
25.0	-.65	.18	-.12	-.00	-34.98	-50.15	.83	.12
30.0	-.70	.13	-.11	-.03	-35.76	-48.27	.83	.08
35.0	-.70	.06	-.09	-.04	-36.36	-47.92	.77	.05
40.0	-.63	-.00	-.07	-.03	-37.34	-48.07	.63	.03
45.0	-.51	-.07	-.05	-.03	-39.57	-49.65	.44	.02
50.0	-.47	-.25	-.02	-.00	-41.93	-48.00	.23	.02
55.0	-.25	-.24	-.02	.01	-47.20	-47.67	.00	.03
60.0	0.00	-.19	0.00	.04	-200.00	-44.98	-.19	.04
65.0	.24	-.10	-.01	.05	-47.23	-45.07	-.34	.05
70.0	.43	.00	-.03	.04	-42.31	-46.42	-.43	.07
75.0	.64	.20	-.05	.03	-38.58	-46.41	-.44	.08
80.0	.77	.39	-.10	-.01	-34.80	-43.19	-.38	.10
85.0	.68	.40	-.15	-.04	-33.41	-41.20	-.27	.11
90.0	.37	.24	-.20	-.08	-33.06	-40.50	-.13	.12
95.0	-.23	-.21	-.20	-.07	-34.37	-42.81	.02	.13
100.0	-.62	-.48	-.16	-.02	-35.47	-43.30	.14	.14
105.0	-1.01	-.80	-.08	.07	-37.60	-39.24	.21	.15
110.0	-1.00	-.76	.02	.18	-40.92	-37.88	.23	.16
TOTAL	.61	.33	.11	.06	-35.89	-43.14		

NET REDUCTION OF MISMATCH ERROR=   7.25DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00430	-.00000
2	0.00000	0.00000	.01063	.00000
3	0.00000	0.00000	-.00853	-.00000
4	1.00000	0.00000	1.01508	.00000
5	0.00000	0.00000	-.00973	-.00000
6	0.00000	0.00000	.00143	.00000
7	0.00005	0.00000	-.00316	-.00000
8	0.00000	0.00000	.00213	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 27 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.62	.03	-.02	.04	-39.37	-46.55	.65	.07
20.0	-.73	.06	-.03	.01	-37.55	-54.16	.79	.04
25.0	-.78	.09	-.03	-.01	-37.16	-54.09	.87	.02
30.0	-.76	.12	-.02	-.02	-38.17	-49.75	.89	-.00
35.0	-.73	.09	-.02	-.03	-38.18	-47.96	.82	-.01
40.0	-.65	.03	-.01	-.03	-38.73	-48.50	.68	-.02
45.0	-.50	-.06	-.01	-.02	-40.49	-51.46	.48	-.02
50.0	-.40	-.16	-.00	-.01	-43.91	-51.57	.24	-.00
55.0	-.20	-.22	.00	.01	-49.50	-48.11	-.02	.01
60.0	0.00	-.25	0.00	.03	-200.00	-44.63	-.25	.03
65.0	.29	-.16	-.01	.04	-45.63	-44.74	-.44	.06
70.0	.51	-.02	-.04	.04	-40.13	-46.38	-.57	.08
75.0	.83	.23	-.06	.03	-35.86	-46.28	-.60	.11
80.0	.93	.37	-.14	-.00	-32.81	-43.70	-.56	.14
85.0	.86	.41	-.21	-.04	-30.89	-41.16	-.45	.17
90.0	.58	.29	-.28	-.08	-30.24	-40.51	-.30	.20
95.0	.05	-.08	-.31	-.07	-30.83	-43.11	-.13	.24
100.0	-.55	-.53	-.30	-.02	-31.25	-42.45	.02	.28
105.0	-1.01	-.89	-.24	.07	-33.31	-38.63	.12	.31
110.0	-1.14	-.47	-.16	.19	-37.27	-36.97	.17	.34
TOTAL	.68	.37	.14	.06	-34.58	-42.95		

NET REDUCTION OF MISMATCH ERROR=   8.37DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00484	-.00000
2	0.00000	0.00000	.00798	-.00000
3	0.00000	0.00000	-.01059	-.00000
4	1.00000	0.00000	1.01674	.00000
5	0.00000	0.00000	-.01277	-.00000
6	0.00000	0.00000	.00412	.00000
7	0.00000	0.00000	-.00342	-.00000
8	0.00000	0.00000	.00277	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 28 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.47	-.01	.01	.05	-41.82	-44.76	.46	.04
20.0	-.35	.23	.02	.03	-43.76	-45.33	.57	.01
25.0	-.47	.17	-.01	-.02	-41.77	-48.71	.64	-.01
30.0	-.60	.06	-.02	-.05	-40.26	-45.73	.65	-.03
35.0	-.59	.02	-.01	-.05	-40.11	-45.09	.60	-.04
40.0	-.45	.04	.00	-.03	-42.02	-48.39	.49	-.04
45.0	-.40	-.03	-.00	-.03	-43.14	-49.60	.32	-.02
50.0	-.37	-.25	.00	-.00	-44.42	-47.84	.12	-.00
55.0	-.18	-.27	-.00	.02	-50.64	-46.28	-.09	.02
60.0	0.00	-.27	0.00	.05	-200.00	-42.59	-.27	.05
65.0	.26	-.15	-.03	.05	-44.96	-44.00	-.40	.08
70.0	.50	.03	-.06	.05	-39.74	-44.93	-.46	.11
75.0	.70	.26	-.10	.04	-36.03	-44.66	-.43	.14
80.0	.76	.44	-.18	-.01	-32.12	-42.13	-.32	.17
85.0	.63	.48	-.26	-.05	-29.99	-39.55	-.15	.20
90.0	.25	.29	-.33	-.09	-29.07	-39.14	.05	.24
95.0	-.45	-.21	-.37	-.09	-29.31	-41.27	.24	.28
100.0	-.84	-.45	-.34	-.02	-29.90	-43.96	.39	.32
105.0	-1.51	-1.04	-.27	.09	-31.44	-37.12	.47	.36
110.0	-1.80	-1.34	-.19	.21	-34.28	-35.16	.46	.40
TOTAL	.71	.45	.17	.07	-33.84	-41.29		

NET REDUCTION OF MISMATCH ERROR= 7.45DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00252	.00000
2	0.00000	0.00000	.02128	-.00000
3	0.00000	0.00000	-.00779	.00000
4	1.00000	0.00000	1.02655	-.00000
5	0.00000	0.00000	-.00505	.00000
6	0.00000	0.00000	.00308	-.00000
7	0.00000	0.00000	-.00251	.00000
8	0.00000	0.00000	.00320	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 29 WITH 8 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.59	.12	-.23	.05	-31.41	-44.14	.71	.28
20.0	-.81	.10	-.21	.02	-30.90	-51.41	.90	.23
25.0	-.93	.11	-.19	-.01	-31.32	-52.81	1.04	.18
30.0	-1.00	.12	-.17	-.03	-32.66	-48.54	1.11	.14
35.0	-1.03	.07	-.14	-.04	-32.01	-46.51	1.10	.09
40.0	-.96	.02	-.10	-.04	-33.72	-46.55	.98	.06
45.0	-.82	-.05	-.07	-.03	-35.76	-49.68	.77	.04
50.0	-.73	-.27	-.04	-.01	-37.09	-47.14	.47	.03
55.0	-.33	-.22	-.02	.02	-44.95	-48.10	.11	.03
60.0	0.00	-.26	0.00	.04	-200.00	-43.68	-.26	.04
65.0	.43	-.18	-.00	.05	-42.38	-43.05	-.61	.05
70.0	.91	.01	-.02	.05	-36.33	-44.57	-.90	.08
75.0	1.24	.15	-.07	.04	-33.37	-46.42	-1.09	.10
80.0	1.63	.45	-.14	.00	-29.70	-41.96	-1.18	.14
85.0	1.68	.53	-.23	-.05	-27.98	-39.09	-1.16	.18
90.0	1.41	.36	-.33	-.10	-27.66	-38.45	-1.05	.23
95.0	.77	-.11	-.39	-.10	-28.47	-40.41	-.87	.29
100.0	.03	-.65	-.39	-.04	-29.25	-40.57	-.67	.36
105.0	-.64	-1.12	-.33	.09	-31.80	-36.54	-.48	.42
110.0	-.91	-1.22	-.23	.25	-36.22	-34.60	-.31	.48
TOTAL	.95	.45	.20	.08	-31.24	-40.92		

NET REDUCTION OF MISMATCH ERROR=   9.68DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00707	-.00000
2	0.00000	0.00000	.01445	-.00000
3	0.00000	0.00000	-.01015	.00000
4	1.00000	0.00000	1.02079	.00000
5	0.00000	0.00000	-.01324	-.00000
6	0.00000	0.00000	.00101	.00000
7	0.00000	0.00000	-.00340	-.00000
8	0.00000	0.00000	.00221	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 30 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREG	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.02	-.02	-.05	.05	-34.82	-44.64	1.00	.11
20.0	-1.13	.08	-.05	.02	-33.66	-51.46	1.21	.07
25.0	-1.14	.19	-.04	-.01	-33.87	-49.35	1.33	.03
30.0	-1.18	.15	-.04	-.04	-34.35	-46.91	1.34	.00
35.0	-1.12	.11	-.03	-.04	-34.46	-45.87	1.23	-.02
40.0	-.99	.03	-.01	-.04	-35.18	-46.15	1.02	-.03
45.0	-.78	-.05	-.01	-.03	-37.32	-48.51	.73	-.03
50.0	-.65	-.26	.01	-.00	-39.55	-47.41	.39	-.01
55.0	-.34	-.30	.00	.02	-45.07	-45.60	.04	.01
60.0	0.00	-.28	0.00	.05	-200.00	-42.67	-.28	.05
65.0	.36	-.18	-.03	.06	-42.99	-42.81	-.53	.08
70.0	.67	-.02	-.07	.05	-37.47	-44.48	-.69	.12
75.0	.97	.23	-.13	.04	-33.63	-45.21	-.74	.17
80.0	1.18	.49	-.21	-.01	-29.90	-41.30	-.69	.21
85.0	1.11	.56	-.30	-.05	-28.00	-38.60	-.55	.25
90.0	.75	.38	-.39	-.10	-27.40	-38.08	-.37	.29
95.0	-.00	-.17	-.42	-.09	-28.23	-41.06	-.16	.33
100.0	-.65	-.64	-.40	-.03	-28.83	-40.93	.02	.37
105.0	-1.30	-1.16	-.32	.09	-31.00	-36.33	.14	.41
110.0	-1.51	-1.32	-.21	.23	-34.81	-34.75	.20	.44
TOTAL	.93	.48	.19	.07	-31.70	-40.71		

NET REDUCTION OF MISMATCH ERROR= 9.01DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.08933	.00000
2	0.00000	0.00000	-.06177	-.00000
3	0.00000	0.00000	.22002	.00000
4	1.00000	0.00000	.01635	-.00000
5	0.00000	0.00000	-.05308	.00000
6	0.00000	0.00000	-.02242	-.00000
7	0.00000	0.00000	-.00538	.00000
8	0.00000	0.00000	-.04001	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 31 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	218.54	-111.90	.19	-22.04	5.36	.01	-330.45	-22.23
20.0	67.16	86.87	-.20	-17.36	.91	.19	21.71	-17.16
25.0	39.64	59.34	.01	-14.01	-3.43	-.84	19.70	-14.02
30.0	-18.64	2.04	.75	-11.31	-9.96	-3.59	20.67	-12.06
35.0	-66.71	-42.54	.26	-10.67	.56	-2.25	24.17	-10.93
40.0	-87.24	-56.89	-.13	-10.50	2.78	-1.13	30.36	-10.37
45.0	-238.85	160.59	.00	-10.13	4.76	2.21	399.44	-10.14
50.0	244.41	-64.57	.01	-9.33	4.15	-1.57	-308.98	-9.95
55.0	-65.42	-1.78	.56	-9.03	.40	-4.36	63.65	-9.60
60.0	0.00	75.37	0.00	-9.08	-200.00	-.24	75.37	-9.08
65.0	-265.22	-180.21	-.01	-8.61	3.39	2.78	85.01	-8.60
70.0	215.34	-52.11	.52	-7.64	5.39	-2.24	-267.45	-8.36
75.0	-40.46	58.18	.40	-7.92	-3.44	-1.90	98.63	-8.52
80.0	-67.53	36.60	-.05	-9.18	1.01	-2.39	104.14	-9.15
85.0	194.21	-55.63	-.17	-10.46	5.99	-1.13	-249.84	-10.29
90.0	-184.19	-66.06	.69	-11.23	5.71	-1.35	118.13	-11.92
95.0	-27.51	-257.63	1.81	-12.00	-6.56	-1.09	-230.12	-13.81
100.0	-68.10	78.17	2.16	-13.24	.12	-2.54	146.27	-15.41
105.0	-254.87	268.88	3.69	-12.33	2.63	-3.25	523.75	-16.02
110.0	-194.80	-16.66	5.89	-9.88	3.56	-8.86	176.13	-15.76
TOTAL	156.55	113.39	2.03	4.69	3.16	-.41		

NET REDUCTION OF MISMATCH ERROR= 3.57DH.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00424	.00000
2	0.00000	0.00000	.02115	-.00000
3	0.00000	0.00000	-.01340	.00000
4	1.00000	0.00000	1.03171	-.00000
5	0.00000	0.00000	-.01343	.00000
6	0.00000	0.00000	.00690	-.00000
7	0.00000	0.00000	-.00491	.00000
8	0.00000	0.00000	.00488	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 32 WITH 8 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.58	.15	-.16	.07	-33.77	-41.48	.73	.23
20.0	-.80	.14	-.16	.03	-32.75	-48.32	.94	.18
25.0	-.92	.17	-.14	-.01	-32.89	-49.63	1.10	.13
30.0	-1.05	.12	-.13	-.05	-33.29	-45.11	1.17	.08
35.0	-1.06	.09	-.11	-.06	-33.49	-43.54	1.15	.05
40.0	-.98	.04	-.08	-.06	-34.17	-43.72	1.02	.03
45.0	-.83	-.06	-.06	-.04	-35.97	-46.61	.77	.02
50.0	-.75	-.31	-.03	-.01	-38.13	-45.98	.44	.02
55.0	-.39	-.34	-.02	.02	-43.58	-44.34	.05	.04
60.0	0.00	-.34	0.00	.06	-200.00	-40.69	-.34	.06
65.0	.44	-.24	-.01	.07	-42.05	-40.43	-.68	.09
70.0	.86	-.06	-.05	.07	-36.35	-42.19	-.92	.12
75.0	1.24	.23	-.11	.05	-32.54	-43.72	-1.03	.16
80.0	1.62	.61	-.21	-.01	-28.57	-39.37	-1.01	.20
85.0	1.60	.74	-.33	-.07	-26.56	-36.26	-.86	.26
90.0	1.19	.56	-.46	-.13	-25.76	-35.49	-.63	.33
95.0	.23	-.13	-.54	-.13	-26.22	-38.19	-.36	.41
100.0	-.74	-.84	-.54	-.05	-26.43	-38.29	-.11	.49
105.0	-1.70	-1.62	-.45	.12	-28.21	-33.51	.08	.57
110.0	-2.13	-1.94	-.32	.33	-41.56	-31.55	.18	.65
TOTAL	1.09	.67	.25	.10	-97	-38.08		

NET REDUCTION OF MISMATCH ERRORS   11DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00518	-.00000
2	0.00000	0.00000	-.00870	.00000
3	0.00000	0.00000	.00816	-.00000
4	0.00000	0.00000	.00914	.00000
5	0.00000	0.00000	-.00193	-.00000
6	1.00000	0.00000	1.01555	.00000
7	0.00000	0.00000	-.00339	-.00000
8	0.00000	0.00000	-.00113	.00000
9	0.00000	0.00000	-.00033	-.00000
10	0.00000	0.00000	.00070	.00000
11	0.00000	0.00000	-.00004	-.00000
12	0.00000	0.00000	.00064	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 2 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.48	.10	-.15	.01	-35.40	-52.58	.58	.15
20.0	-.68	.02	-.13	-.01	-34.29	-61.27	.70	.12
25.0	-.79	-.03	-.12	-.01	-34.45	-58.11	.77	.11
30.0	-.86	-.06	-.11	-.01	-35.02	-54.81	.80	.09
35.0	-.89	-.08	-.09	.00	-35.12	-57.77	.81	.09
40.0	-.81	-.01	-.07	.01	-35.89	-57.88	.80	.08
45.0	-.68	.06	-.05	.01	-37.76	-55.24	.74	.06
50.0	-.63	-.02	-.02	.01	-39.62	-58.38	.61	.03
55.0	-.34	.06	-.02	-.01	-44.81	-57.82	.40	.01
60.0	0.00	.08	0.00	-.01	-200.00	-55.12	.08	-.01
65.0	.50	-.00	-.01	-.02	-45.32	-54.77	-.30	-.00
70.0	.60	-.10	-.04	-.01	-39.44	-54.27	-.70	.03
75.0	.88	-.14	-.07	.01	-35.73	-51.77	-1.02	.08
80.0	1.16	-.00	-.14	.02	-31.66	-54.31	-1.16	.16
85.0	1.15	.07	-.22	.02	-29.98	-53.10	-1.08	.23
90.0	.91	.14	-.30	-.01	-29.28	-52.11	-.77	.29
95.0	.29	-.00	-.33	-.02	-30.16	-54.78	-.24	.31
100.0	-.27	-.03	-.33	-.02	-30.73	-54.30	.24	.31
105.0	-.81	-.13	-.26	.00	-33.26	-56.06	.68	.27
110.0	-.96	-.06	-.17	.03	-37.68	-53.47	.90	.20
TOTAL	.45	.03	.16	.01	-33.32	-54.12		

NET REDUCTION OF MISMATCH ERROR= 20.81DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00879	.00000
2	0.00000	0.00000	-.01345	-.00000
3	0.00000	0.00000	.01853	.00000
4	0.00000	0.00000	.00490	-.00000
5	0.00000	0.00000	-.00268	.00000
6	1.00000	0.00000	1.01733	-.00000
7	0.00000	0.00000	-.01225	.00000
8	0.00000	0.00000	.00095	-.00000
9	0.00000	0.00000	-.00370	.00000
10	0.00000	0.00000	.00165	-.00000
11	0.00000	0.00000	-.00131	.00000
12	0.00000	0.00000	.00078	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 3 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.10	.05	-.07	.02	-33.90	-51.62	1.15	.09
20.0	-1.19	.08	-.07	-.01	-32.96	-54.70	1.27	.06
25.0	-1.28	-.02	-.06	-.02	-32.75	-53.03	1.26	.04
30.0	-1.22	-.04	-.04	-.01	-34.11	-55.65	1.17	.03
35.0	-1.15	-.09	-.02	.00	-34.27	-56.36	1.06	.03
40.0	-1.01	-.06	-.01	.01	-34.98	-54.14	.95	.02
45.0	-.84	-.00	.00	.02	-36.69	-53.33	.84	.02
50.0	-.61	.08	.01	.01	-40.14	-55.25	.69	.00
55.0	-.31	.13	.01	-.01	-45.75	-53.11	.44	-.01
60.0	0.00	.07	0.00	-.02	-200.00	-52.37	.07	-.02
65.0	.36	-.02	-.03	-.02	-43.09	-52.68	-.38	.01
70.0	.70	-.12	-.07	-.01	-37.03	-53.11	-.83	.07
75.0	.99	-.13	-.15	.01	-33.02	-51.63	-1.12	.16
80.0	1.07	-.06	-.24	.02	-29.46	-50.32	-1.13	.27
85.0	.85	.07	-.35	.02	-27.32	-52.59	-.78	.37
90.0	.26	.18	-.46	-.01	-26.46	-50.22	-.09	.44
95.0	-.69	.12	-.50	-.03	-26.65	-50.13	.81	.47
100.0	-1.77	-.06	-.47	-.02	-26.48	-52.38	1.71	.45
105.0	-2.51	-.14	-.36	.01	-28.08	-55.26	2.37	.37
110.0	-2.81	-.24	-.23	.04	-31.01	-49.97	2.57	.27
TOTAL	1.24	.10	.23	.02	-30.39	-51.82		

NET REDUCTION OF MISMATCH ERROR=   21.43DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00279	-.00000
2	0.00000	0.00000	-.00609	-.00000
3	0.00000	0.00000	.00767	-.00000
4	0.00000	0.00000	-.00214	-.00000
5	0.00000	0.00000	.00170	-.00000
6	1.00000	0.00000	1.00208	-.00000
7	0.00000	0.00000	-.00243	.00000
8	0.00000	0.00000	-.00271	-.00000
9	0.00000	0.00000	.00013	.00000
10	0.00000	0.00000	-.00048	-.00000
11	0.00000	0.00000	.00020	.00000
12	0.00000	0.00000	-.00002	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 4 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.28	.04	.01	.00	-46.41	-61.17	.32	-.00
20.0	-.36	.01	-.00	-.00	-43.86	-70.25	.37	-.00
25.0	-.41	-.02	-.00	-.00	-43.01	-69.60	.39	-.00
30.0	-.43	-.03	-.01	-.01	-43.24	-60.93	.40	.00
35.0	-.44	-.04	-.01	.00	-42.67	-63.11	.40	.01
40.0	-.38	.01	-.01	.00	-43.53	-65.32	.39	.01
45.0	-.30	.06	-.01	.00	-45.58	-59.38	.36	.01
50.0	-.35	-.05	.00	.01	-45.08	-60.30	.30	.00
55.0	-.17	.02	-.00	-.01	-51.19	-63.14	.19	-.00
60.0	0.00	.04	0.00	-.00	-200.00	-63.62	.04	-.00
65.0	.13	.00	-.02	-.01	-50.67	-63.55	-.13	.01
70.0	.23	-.05	-.04	-.00	-45.22	-60.55	-.28	.03
75.0	.28	-.08	-.06	.01	-42.27	-56.72	-.35	.07
80.0	.35	.03	-.10	.00	-57.81	-62.93	-.32	.10
85.0	.22	.05	-.13	.01	-56.30	-58.17	-.16	.13
90.0	-.04	.06	-.16	-.01	-55.63	-58.36	.10	.15
95.0	-.40	-.08	-.14	-.00	-56.42	-58.54	.41	.14
100.0	-.73	-.03	-.11	-.00	-57.24	-65.86	.70	.10
105.0	-.93	-.04	-.04	.00	-59.05	-65.34	.89	.04
110.0	-.83	.09	.04	.01	-42.26	-61.23	.02	-.03
TOTAL	.43	.05	.07	.00	-40.03	-60.55		

NET REDUCTION OF MISMATCH ERROR= 20.52DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00637	.00000
2	0.00000	0.00000	-.00771	-.00000
3	0.00000	0.00000	.01064	.00000
4	0.00000	0.00000	.00628	-.00000
5	0.00000	0.00000	-.01424	.00000
6	1.00000	0.00000	1.01359	-.00000
7	0.00000	0.00000	-.02073	.00000
8	0.00000	0.00000	.00036	-.00000
9	0.00000	0.00000	-.00531	.00000
10	0.00000	0.00000	.00155	-.00000
11	0.00000	0.00000	-.00179	.00000
12	0.00000	0.00000	.00077	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 5 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.06	.03	.14	.02	-32.38	-53.80	1.09	-.12
20.0	-1.14	.04	.12	-.01	-32.07	-58.54	1.18	-.13
25.0	-1.13	.01	.11	-.02	-32.61	-54.77	1.14	-.13
30.0	-1.03	-.02	.10	-.01	-34.24	-58.96	1.01	-.11
35.0	-.92	-.06	.09	.00	-34.87	-60.01	.86	-.09
40.0	-.77	-.06	.07	.01	-35.89	-55.76	.71	-.06
45.0	-.61	-.01	.06	.02	-38.01	-55.05	.60	-.04
50.0	-.46	.02	.04	.01	-41.24	-60.57	.48	-.03
55.0	-.21	.11	.02	-.00	-47.41	-54.97	.32	-.03
60.0	0.00	.08	0.00	-.01	-200.00	-54.05	.08	-.01
65.0	.25	.01	-.04	-.02	-44.46	-54.02	-.24	.02
70.0	.49	-.09	-.08	-.01	-38.52	-55.56	-.57	.07
75.0	.73	-.11	-.14	.01	-34.49	-53.83	-.83	.15
80.0	.80	-.10	-.22	.02	-30.86	-50.73	-.90	.24
85.0	.74	.03	-.31	.02	-28.46	-54.61	-.72	.32
90.0	.43	.16	-.40	-.01	-27.39	-51.52	-.27	.40
95.0	-.20	.16	-.47	-.02	-27.36	-50.19	.35	.45
100.0	-.98	.02	-.49	-.02	-27.05	-53.44	1.00	.46
105.0	-1.64	-.15	-.45	.00	-28.34	-54.97	1.49	.45
110.0	-2.01	-.35	-.38	.04	-31.01	-48.06	1.66	.42
TOTAL	.92	.11	.24	.02	-30.98	-52.90		

NET REDUCTION OF MISMATCH ERROR= 21.91DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00815	.00000
2	0.00000	0.00000	-.00939	-.00000
3	0.00000	0.00000	.01446	.00000
4	0.00000	0.00000	.00903	-.00000
5	0.00000	0.00000	-.01114	.00000
6	1.00000	0.00000	1.01769	-.00000
7	0.00000	0.00000	-.01966	.00000
8	0.00000	0.00000	-.00078	-.00000
9	0.00000	0.00000	-.00552	.00000
10	0.00000	0.00000	.00056	-.00000
11	0.00000	0.00000	-.00211	.00000
12	0.00000	0.00000	.00029	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 6 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.67	-.10	.04	.01	-30.81	-52.97	1.57	-.03
20.0	-1.50	.08	.04	-.00	-30.83	-56.00	1.68	-.05
25.0	-1.48	.10	.04	-.01	-31.65	-53.57	1.58	-.05
30.0	-1.37	.01	.03	-.02	-33.13	-55.49	1.38	-.05
35.0	-1.24	-.10	.04	-.00	-33.47	-55.52	1.14	-.04
40.0	-1.04	-.02	.04	.01	-34.53	-53.94	.95	-.03
45.0	-.80	-.00	.03	.01	-36.81	-57.20	.80	-.02
50.0	-.60	-.03	.03	.01	-38.75	-57.07	.66	-.02
55.0	-.34	.11	.01	-.01	-44.86	-54.35	.45	-.02
60.0	0.00	.14	0.00	-.01	-200.00	-51.56	.14	-.01
65.0	.32	.05	-.04	-.02	-42.93	-53.26	-.27	.02
70.0	.60	-.11	-.09	-.01	-37.13	-53.15	-.71	.08
75.0	.83	-.20	-.15	.01	-33.45	-49.06	-1.04	.16
80.0	1.06	-.08	-.25	.02	-29.37	-51.89	-1.13	.27
85.0	.96	.05	-.35	.02	-27.22	-52.72	-.92	.37
90.0	.59	.20	-.46	-.01	-26.22	-49.61	-.39	.45
95.0	-.23	.10	-.53	-.02	-26.35	-51.76	.34	.50
100.0	-1.02	.07	-.54	-.02	-26.22	-52.40	1.09	.51
105.0	-1.46	-.20	-.48	.00	-27.63	-52.82	1.66	.48
110.0	-2.23	-.36	-.39	.04	-30.58	-47.93	1.87	.43
TOTAL	1.15	.14	.25	.02	-29.91	-51.73		

NET REDUCTION OF MISMATCH ERROR: 21.83DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00878	-.00000
2	0.00000	0.00000	-.01407	-.00000
3	0.00000	0.00000	.01808	.00000
4	0.00000	0.00000	.00257	-.00000
5	0.00000	0.00000	-.00258	.00000
6	1.00000	0.00000	1.01552	-.00000
7	0.00000	0.00000	-.01135	-.00000
8	0.00000	0.00000	.00093	-.00000
9	0.00000	0.00000	-.00312	-.00000
10	0.00000	0.00000	.00180	-.00000
11	0.00000	0.00000	-.00110	-.00000
12	0.00000	0.00000	.00089	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 7 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.85	.08	-.05	.02	-36.54	-50.87		
20.0	-.90	.05	-.05	-.01	-34.75	-57.10	.95	.07
25.0	-1.06	-.02	-.04	-.02	-34.49	-52.20	1.03	.04
30.0	-1.02	-.04	-.03	-.01	-35.70	-56.12	1.03	.02
35.0	-.90	-.09	-.02	.00	-35.55	-56.42	.98	.02
40.0	-.91	-.07	-.01	.01	-35.05	-53.68	.90	.02
45.0	-.74	.02	-.00	.02	-37.80	-52.97	.83	.03
50.0	-.55	.08	.01	.01	-41.05	-55.02	.76	.02
55.0	-.20	.13	.01	-.01	-46.51	-53.51	.63	.00
60.0	0.00	.07	0.00	-.02	-260.00	-52.88	.41	-.01
65.0	.54	-.04	-.05	-.02	-43.54	-52.40	.07	-.02
70.0	.67	-.13	-.07	-.01	-37.31	-52.37	-.37	.01
75.0	.90	-.10	-.14	.01	-33.14	-52.98	-.80	.08
80.0	1.04	-.05	-.24	.03	-29.71	-49.94	-1.09	.16
85.0	.70	.06	-.35	.02	-27.52	-53.22	-1.09	.26
90.0	.20	.17	-.44	-.01	-26.69	-50.63	-.73	.36
95.0	-.77	.10	-.49	-.03	-26.83	-49.95	-.03	.43
100.0	-1.81	-.03	-.45	-.02	-26.78	-53.70	.87	.45
105.0	-2.60	-.16	-.33	.01	-28.24	-53.94	1.78	.42
110.0	-2.86	-.22	-.19	.04	-31.17	-50.54	2.44	.54
TOTAL	1.20	.10	.21	.02	-30.63	-51.90	2.64	.23

NET REDUCTION OF MISMATCH ERROR= 21.08DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00104	-.00000
2	0.00000	0.00000	-.00245	-.00000
3	0.00000	0.00000	.00418	-.00000
4	0.00000	0.00000	.00188	-.00000
5	0.00000	0.00000	.00649	-.00000
6	1.00000	0.00000	1.00014	-.00000
7	0.00000	0.00000	.00574	.00000
8	0.00000	0.00000	-.00659	-.00000
9	0.00000	0.00000	.00207	.00000
10	0.00000	0.00000	-.00269	-.00000
11	0.00000	0.00000	.00075	.00000
12	0.00000	0.00000	-.00101	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 8 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.59	-.07	-.10	-.01	-56.68	-57.88	.52	.09
20.0	-.55	.03	-.09	.00	-37.01	-65.21	.57	.09
25.0	-.53	.04	-.08	.01	-38.00	-58.13	.57	.09
30.0	-.56	-.02	-.08	-.00	-58.55	-69.35	.54	.07
35.0	-.52	-.03	-.06	-.00	-39.21	-67.37	.49	.06
40.0	-.43	.02	-.05	-.00	-40.53	-68.56	.45	.05
45.0	-.30	.05	-.04	-.01	-42.71	-59.79	.39	.03
50.0	-.37	-.07	-.02	.00	-44.04	-58.87	.30	.02
55.0	-.18	-.01	-.02	-.00	-49.22	-68.86	.17	.01
60.0	0.00	.02	0.00	.01	-200.00	-60.51	.02	.01
65.0	.15	.01	-.00	.00	-51.70	-72.82	-.14	.01
70.0	.25	-.02	-.01	-.00	-47.54	-67.92	-.27	.01
75.0	.33	-.03	-.01	.00	-45.18	-65.93	-.36	.01
80.0	.43	.04	-.03	-.01	-41.69	-60.60	-.39	.02
85.0	.42	.05	-.03	-.00	-41.55	-61.38	-.38	.03
90.0	.36	.02	-.04	-.01	-43.07	-63.58	-.35	.03
95.0	.18	-.14	-.01	.01	-51.75	-55.54	-.32	.01
100.0	.24	-.05	.05	.01	-47.29	-59.46	-.30	-.02
105.0	.27	-.01	.08	.00	-43.15	-70.89	-.28	-.08
110.0	.56	.51	.13	-.02	-40.98	-50.66	-.25	-.14
TOTAL	.40	.08	.06	.01	-40.79	-58.51		

NET REDUCTION OF MISMATCH ERROR= 17.72DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00673	-.00000
2	0.00000	0.00000	-.01018	.00000
3	0.00000	0.00000	.01033	-.00000
4	0.00000	0.00000	.00726	.00000
5	0.00000	0.00000	-.00858	-.00000
6	1.00000	0.00000	1.01609	.00000
7	0.00000	0.00000	-.01171	-.00000
8	0.00000	0.00000	.00097	.00000
9	0.00000	0.00000	-.00290	-.00000
10	0.00000	0.00000	.00147	-.00000
11	0.00000	0.00000	-.00099	-.00000
12	0.00000	0.00000	.00102	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 4 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.55	.13	-.01	.02	-40.61	-49.71	.68	.03
20.0	-.75	.02	-.02	-.01	-57.42	-56.26	.77	.01
25.0	-.85	-.05	-.02	-.02	-36.59	-52.66	.79	.00
30.0	-.83	-.05	-.02	-.01	-37.52	-55.49	.78	.00
35.0	-.81	-.07	-.01	.00	-57.35	-58.47	.74	.01
40.0	-.74	-.04	-.01	.01	-57.68	-54.99	.70	.02
45.0	-.63	.02	-.00	.02	-39.30	-53.39	.65	.02
50.0	-.48	.06	.00	.01	-42.23	-57.10	.54	.01
55.0	-.24	.12	.00	-.00	-48.18	-54.17	.35	-.01
60.0	0.00	.05	0.00	-.02	-200.00	-53.70	.05	-.02
65.0	.32	-.03	-.02	-.02	-44.55	-52.97	-.34	-.00
70.0	.66	-.12	-.06	-.01	-38.33	-53.17	-.76	.05
75.0	.99	-.09	-.11	.01	-34.05	-54.34	-1.08	.12
80.0	1.13	-.06	-.19	.02	-30.66	-50.44	-1.19	.21
85.0	1.07	.06	-.21	.02	-28.48	-52.90	-1.02	.50
90.0	.70	.15	-.38	-.01	-27.65	-51.82	-.55	.37
95.0	-.00	.11	-.44	-.03	-27.87	-50.14	.11	.41
100.0	-.84	-.02	-.44	-.03	-27.91	-52.80	.82	.42
105.0	-1.52	-.14	-.38	.01	-29.56	-55.22	1.37	.38
110.0	-1.85	-.25	-.29	.04	-32.66	-49.26	1.60	.53
TOTAL	.87	.10	.20	.02	-32.04	-52.17		

NET REDUCTION OF MISMATCH ERROR= 20.13DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00286	-.00000
2	0.00000	0.00000	-.00419	.00000
3	0.00000	0.00000	.00385	-.00000
4	0.00000	0.00000	.00846	.00000
5	0.00000	0.00000	.00102	-.00000
6	1.00000	0.00000	1.00905	.00000
7	0.00000	0.00000	.00214	-.00000
8	0.00000	0.00000	-.00425	.00000
9	0.00000	0.00000	.00090	-.00000
10	0.00000	0.00000	-.00120	.00000
11	0.00000	0.00000	.00031	-.00000
12	0.00000	0.00000	-.00029	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 10 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.60	-.00	-.13	.00	-34.87	-69.58	.60	.14
20.0	-.65	.02	-.13	-.00	-34.62	-67.99	.68	.12
25.0	-.67	.03	-.11	.00	-35.39	-65.40	.70	.11
30.0	-.71	-.03	-.11	-.01	-36.02	-60.18	.68	.10
35.0	-.71	-.06	-.09	-.00	-36.34	-59.95	.65	.09
40.0	-.62	-.01	-.07	.00	-37.42	-65.73	.61	.07
45.0	-.50	.05	-.05	.00	-39.57	-60.29	.55	.06
50.0	-.40	-.05	-.03	.01	-41.44	-59.39	.44	.04
55.0	-.24	.04	-.02	-.01	-46.85	-61.04	.28	.02
60.0	0.00	.05	0.00	.00	-200.00	-61.14	.05	.00
65.0	.23	.00	-.00	-.01	-47.72	-61.96	-.23	-.00
70.0	.46	-.06	-.01	-.01	-42.21	-57.61	-.52	.01
75.0	.68	-.09	-.03	.01	-38.85	-56.26	-.76	.03
80.0	.94	.02	-.06	.00	-34.86	-63.66	-.92	.07
85.0	1.00	.05	-.10	.01	-33.55	-57.33	-.95	.11
90.0	.94	.08	-.15	-.01	-33.31	-56.95	-.86	.14
95.0	.61	-.06	-.16	-.01	-35.19	-53.46	-.68	.16
100.0	.42	-.03	-.16	-.01	-36.51	-61.65	-.45	.15
105.0	.15	-.09	-.11	.00	-41.17	-59.63	-.23	.12
110.0	.19	.12	-.06	.01	-48.48	-57.77	-.07	.07
TOTAL	.60	.06	.09	.01	-36.43	-59.31		

NET REDUCTION OF MISMATCH ERROR=   22.87DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00481	-.00000
2	0.00000	0.00000	-.00796	.00000
3	0.00000	0.00000	.00850	-.00000
4	0.00000	0.00000	.00428	.00000
5	0.00000	0.00000	-.00546	-.00000
6	1.00000	0.00000	1.01052	.00000
7	0.00000	0.00000	-.00841	-.00000
8	0.00000	0.00000	-.00048	.00000
9	0.00000	0.00000	-.00191	-.00000
10	0.00000	0.00000	.00101	.00000
11	0.00000	0.00000	-.00044	-.00000
12	0.00000	0.00000	.00046	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 11 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.44	.10	.00	.01	-42.51	-52.59	.54	.01
20.0	-.61	.01	-.00	-.01	-39.37	-62.58	.62	-.00
25.0	-.68	-.04	-.01	-.01	-38.54	-55.12	.64	-.01
30.0	-.67	-.04	-.01	-.01	-39.43	-59.65	.63	-.00
35.0	-.67	-.06	-.00	.00	-39.06	-60.33	.61	.01
40.0	-.61	-.03	-.00	.01	-39.43	-58.71	.58	.01
45.0	-.51	.02	.00	.01	-41.10	-56.74	.53	.01
50.0	-.37	.06	.00	.01	-44.44	-58.54	.43	.00
55.0	-.19	.08	.00	-.00	-50.08	-57.58	.27	-.01
60.0	0.00	.02	0.00	-.01	-200.00	-58.21	.02	-.01
65.0	.26	-.03	-.02	-.01	-46.22	-55.37	-.28	.00
70.0	.50	-.09	-.04	-.00	-40.52	-56.05	-.59	.04
75.0	.77	-.04	-.09	.01	-36.24	-59.27	-.81	.09
80.0	.83	-.03	-.14	.02	-33.06	-54.30	-.86	.16
85.0	.74	.04	-.22	.01	-31.06	-56.76	-.70	.23
90.0	.44	.10	-.28	-.01	-30.26	-54.96	-.34	.28
95.0	-.11	.05	-.32	-.02	-30.57	-54.29	.16	.30
100.0	-.72	-.05	-.31	-.02	-30.70	-55.99	.67	.30
105.0	-1.15	-.09	-.26	.01	-32.65	-59.20	1.06	.26
110.0	-1.30	-.10	-.18	.03	-36.13	-54.82	1.21	.21
TOTAL	.66	.06	.15	.01	-34.54	-55.74		

NET REDUCTION OF MISMATCH ERROR=   21.09DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00381	-.00000
2	0.00000	0.00000	-.00687	.00000
3	0.00000	0.00000	.00484	-.00000
4	0.00000	0.00000	.00398	.00000
5	0.00000	0.00000	-.00620	-.00000
6	1.00000	0.00000	1.00872	-.00000
7	0.00000	0.00000	-.00669	-.00000
8	0.00000	0.00000	-.00168	.00000
9	0.00000	0.00000	-.00066	-.0.0000
10	0.00000	0.00000	.00042	.00000
11	0.00000	0.00000	-.00002	-.00000
12	0.00000	0.00000	.00055	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 12 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.18	.11	.03	.01	-47.15	-52.61	.29	-.02
20.0	-.36	-.00	.01	-.01	-43.66	-63.36	.36	-.02
25.0	-.45	-.04	.00	-.01	-42.11	-58.42	.41	-.01
30.0	-.51	-.07	-.01	-.01	-41.68	-55.72	.45	.00
35.0	-.53	-.05	-.01	.00	-41.05	-61.53	.48	.01
40.0	-.47	.02	-.01	.01	-41.51	-58.81	.49	.02
45.0	-.40	.07	-.01	.01	-42.90	-55.99	.47	.02
50.0	-.46	-.04	-.01	.01	-42.53	-58.01	.41	.01
55.0	-.27	.06	-.01	-.01	-48.74	-58.28	.27	.00
60.0	0.00	.06	0.00	-.00	-200.00	-58.36	.06	-.00
65.0	.21	-.00	-.01	-.01	-47.98	-57.04	-.21	.00
70.0	.42	-.07	-.04	-.01	-41.82	-57.12	-.49	.03
75.0	.50	-.13	-.07	.01	-58.38	-52.85	-.72	.08
80.0	.82	-.00	-.12	.01	-33.86	-57.58	-.82	.13
85.0	.84	.07	-.18	.01	-31.92	-53.86	-.76	.19
90.0	.63	.10	-.24	-.01	-31.19	-55.06	-.53	.24
95.0	.15	-.02	-.27	-.02	-31.88	-56.37	-.18	.26
100.0	-.23	-.01	-.27	-.02	-32.39	-57.16	.22	.25
105.0	-.63	-.09	-.22	.00	-34.75	-59.73	.54	.22
110.0	-.76	-.06	-.15	.03	-39.08	-55.09	.70	.18
TOTAL	.50	.06	.13	.01	-36.11	-55.73		

NET REDUCTION OF MISMATCH ERROR= 19.63DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00365	.00000
2	0.00000	0.00000	-.00662	-.00000
3	0.00000	0.00000	.00971	.00000
4	0.00000	0.00000	-.00222	.00000
5	0.00000	0.00000	.00228	.00000
6	1.00000	0.00000	1.00239	-.00000
7	0.00000	0.00000	-.00294	-.00000
8	0.00000	0.00000	-.00256	-.00000
9	0.00000	0.00000	-.00049	-.00000
10	0.00000	0.00000	-.00058	-.00000
11	0.00000	0.00000	-.00004	-.00000
12	0.00000	0.00000	-.00004	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 13 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	FORE	AFTER	BEFORE	AFTER		
15.0	-.40	.02	-.00	.01	-41.62	-62.70	.51	.01
20.0	-.54	.01	-.00	-.00	-40.36	-69.30	.55	.00
25.0	-.54	.00	-.00	-.01	-40.51	-62.70	.54	-.00
30.0	-.51	-.01	-.00	-.00	-41.77	-68.10	.50	.00
35.0	-.40	-.03	-.00	.00	-41.82	-65.58	.46	.00
40.0	-.43	-.03	-.00	.00	-42.37	-63.04	.41	.01
45.0	-.35	.01	.00	.01	-44.30	-62.15	.36	.00
50.0	-.25	.03	.00	.00	-47.81	-66.26	.28	-.00
55.0	-.13	.04	.00	-.00	-53.61	-62.39	.17	-.00
60.0	0.00	.01	0.00	-.00	-200.00	-65.44	.01	-.00
65.0	.16	-.01	-.01	-.01	-49.99	-65.30	-.16	.01
70.0	.29	-.03	-.03	-.00	-44.38	-64.78	-.32	.03
75.0	.39	-.10	-.07	.00	-41.42	-54.97	-.40	.07
80.0	.38	.03	-.10	.01	-37.19	-59.60	-.35	.11
85.0	.22	.07	-.15	.00	-35.22	-57.96	-.16	.15
90.0	-.12	.04	-.18	-.01	-34.60	-60.33	.16	.17
95.0	-.57	-.02	-.17	-.01	-35.11	-61.56	.55	.16
100.0	-.96	-.06	-.12	-.00	-35.42	-61.83	.91	.12
105.0	-1.19	-.05	-.05	.01	-36.95	-63.12	1.14	.05
110.0	-1.09	.09	.03	.00	-40.06	-61.80	1.17	-.03
TOTAL	.55	.04	.07	.00	-38.62	-60.00		

NET REDUCTION OF MISMATCH ERROR= 22.29DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00756	.00000
2	0.00000	0.00000	-.01357	-.00000
3	0.00000	0.00000	.01418	-.00000
4	0.00000	0.00000	.00698	.00000
5	0.00000	0.00000	-.00632	-.00000
6	1.00000	0.00000	1.02101	-.00000
7	0.00000	0.00000	-.01245	.00000
8	0.00000	0.00000	.00341	-.00000
9	0.00000	0.00000	-.00239	.00000
10	0.00000	0.00000	.00345	-.00000
11	0.00000	0.00000	-.00058	.00000
12	0.00000	0.00000	.00196	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 14 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.28	.22	-.08	.03	-40.11	-46.29	.51	.10
20.0	-.66	.01	-.08	-.01	-36.65	-57.16	.66	.07
25.0	-.87	-.08	-.07	-.02	-35.49	-50.90	.79	.04
30.0	-1.01	-.13	-.06	-.02	-35.25	-50.09	.89	.04
35.0	-1.04	-.10	-.04	.00	-34.97	-55.40	.93	.05
40.0	-.94	-.00	-.03	.02	-35.55	-52.79	.93	.05
45.0	-.78	.09	-.02	.02	-37.33	-50.55	.86	.04
50.0	-.70	.01	.00	.02	-38.97	-54.73	.72	.02
55.0	-.36	.10	-.00	-.01	-44.59	-54.13	.46	-.01
60.0	0.00	.09	0.00	-.02	-200.00	-51.53	.09	-.02
65.0	.34	-.01	-.03	-.03	-42.92	-50.12	-.36	.00
70.0	.68	-.14	-.08	-.01	-37.16	-51.52	-.82	.06
75.0	.96	-.18	-.14	.02	-33.23	-49.02	-1.14	.16
80.0	1.18	-.04	-.24	.03	-29.17	-49.13	-1.21	.27
85.0	1.04	.09	-.35	.03	-27.06	-49.57	-.95	.38
90.0	.55	.20	-.47	-.01	-26.08	-48.92	-.35	.48
95.0	-.41	.07	-.53	-.03	-26.33	-49.37	.48	.49
100.0	-1.33	.02	-.52	-.03	-26.32	-50.06	1.35	.48
105.0	-2.21	-.20	-.43	.01	-27.84	-52.53	2.01	.43
110.0	-2.56	-.30	-.30	.06	-30.94	-46.94	2.26	.36
TOTAL	1.08	.13	.24	.02	-30.48	-49.60		

NET REDUCTION OF MISMATCH ERROR=   19.15DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00800	-.00000
2	0.00000	0.00000	-.01362	-.00000
3	0.00000	0.00000	.01482	-.00000
4	0.00000	0.00000	.00960	.00000
5	0.00000	0.00000	-.00429	.00000
6	1.00000	0.00000	1.02218	-.00000
7	0.00000	0.00000	-.00928	-.00000
8	0.00000	0.00000	.00224	-.00000
9	0.00000	0.00000	-.00225	-.00000
10	0.00000	0.00000	.00268	-.00000
11	0.00000	0.00000	-.00064	-.00000
12	0.00000	0.00000	.00150	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 15 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.53	.19	-.14	.03	-34.80	-47.06	.73	.17
20.0	-.86	.02	-.14	-.01	-33.15	-57.49	.88	.13
25.0	-1.06	-.06	-.12	-.03	-32.80	-50.01	.98	.10
30.0	-1.13	-.10	-.10	-.02	-33.69	-52.59	1.04	.08
35.0	-1.13	-.09	-.08	.00	-33.74	-50.82	1.05	.08
40.0	-1.05	-.04	-.05	.02	-34.23	-53.53	1.02	.07
45.0	-.89	.04	-.03	.02	-36.05	-51.13	.93	.05
50.0	-.67	.09	-.01	.01	-39.37	-53.96	.76	.02
55.0	-.35	.12	-.00	-.01	-44.94	-55.38	.47	-.01
60.0	0.00	.05	0.00	-.02	-200.00	-52.12	.05	-.02
65.0	.41	-.05	-.02	-.02	-42.35	-50.45	-.46	-.00
70.0	.83	-.14	-.06	-.01	-36.27	-51.77	-.97	.05
75.0	1.25	-.10	-.13	.02	-32.18	-52.61	-1.35	.15
80.0	1.39	-.05	-.23	.03	-28.92	-48.72	-1.44	.26
85.0	1.26	.07	-.35	.02	-26.90	-51.39	-1.19	.37
90.0	.77	.18	-.46	-.01	-26.16	-49.80	-.58	.45
95.0	-.15	.11	-.52	-.04	-26.52	-48.75	.26	.48
100.0	-1.18	-.04	-.50	-.03	-26.66	-51.30	1.14	.47
105.0	-2.01	-.18	-.41	.01	-28.36	-53.24	1.83	.42
110.0	-2.34	-.24	-.26	.05	-31.59	-48.49	2.10	.34
TOTAL	1.11	.12	.24	.02	-30.25	-50.34		

NET REDUCTION OF MISMATCH ERROR= 20.10DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00650	-.00000
2	0.00000	0.00000	-.01042	-.00000
3	0.00000	0.00000	.00974	.00000
4	0.00000	0.00000	.01025	-.00000
5	0.00000	0.00000	-.00494	.00000
6	1.00000	0.00000	1.01960	.00000
7	0.00000	0.00000	-.00733	-.00000
8	0.00000	0.00000	.00141	.00000
9	0.00000	0.00000	-.00161	-.00000
10	0.00000	0.00000	.00208	.00000
11	0.00000	0.00000	-.00050	-.00000
12	0.00000	0.00000	.00125	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 16 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES) BEFORE	AFTER	AMPLITUDE ERROR (DB) BEFORE	AFTER	TOTAL MS ERROR (DB POWER) BEFORE	AFTER	FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
15.0	-.45	.14	-.13	.02	-35.85	-49.83	.59	.15
20.0	-.69	.02	-.12	-.01	-34.50	-59.65	.71	.12
25.0	-.83	-.04	-.11	-.02	-34.46	-54.43	.79	.09
30.0	-.91	-.08	-.10	-.02	-34.91	-52.53	.84	.08
35.0	-.93	-.08	-.08	.00	-35.00	-57.14	.85	.08
40.0	-.86	-.03	-.06	.01	-35.58	-55.28	.84	.05
45.0	-.73	.06	-.04	.02	-37.51	-52.78	.78	.06
50.0	-.67	-.01	-.02	.01	-39.28	-56.17	.66	.03
55.0	-.34	.09	-.01	-.01	-44.84	-55.12	.43	.00
60.0	0.00	.10	0.00	-.01	-200.00	-53.14	.10	-.01
65.0	.33	-.00	-.02	-.02	-44.17	-51.91	-.34	-.00
70.0	.68	-.11	-.05	-.01	-38.11	-53.03	-.79	.04
75.0	.97	-.18	-.10	.01	-34.48	-49.82	-1.15	.11
80.0	1.26	-.05	-.18	.02	-30.42	-50.92	-1.30	.20
85.0	1.26	.09	-.27	.02	-28.38	-50.47	-1.17	.29
90.0	.93	.17	-.37	-.01	-27.58	-50.48	-.75	.37
95.0	.18	.06	-.43	-.03	-28.03	-50.85	-.12	.40
100.0	-.56	.01	-.43	-.03	-28.23	-51.37	.57	.40
105.0	-1.30	-.17	-.37	.00	-30.09	-54.00	1.13	.37
110.0	-1.64	-.25	-.26	.05	-33.53	-48.35	1.39	.32
TOTAL	.87	.11	.21	.02	-31.77	-51.42		

NET REDUCTION OF MISMATCH ERROR= 19.66DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00612	.00000
2	0.00000	0.00000	-.00816	.00000
3	0.00000	0.00000	.01185	.00000
4	0.00000	0.00000	.00374	-.00000
5	0.00000	0.00000	.00009	.00000
6	1.00000	0.00000	1.00888	-.00000
7	0.00000	0.00000	-.00499	.00000
8	0.00000	0.00000	-.00316	.00000
9	0.00000	0.00000	-.00196	.00000
10	0.00000	0.00000	-.00094	.00000
11	0.00000	0.00000	-.00081	.00000
12	0.00000	0.00000	-.00050	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 17 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES) BEFORE	AFTER	AMPLITUDE ERROR (DB) BEFORE	AFTER	TOTAL MS ERROR (DB POWER) BEFORE	AFTER	FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
15.0	-1.16	-.09	-.06	.01	-33.74	-55.57	1.07	.06
20.0	-1.05	.07	-.05	-.00	-34.16	-58.20	1.12	.05
25.0	-.96	.07	-.05	-.01	-35.17	-56.64	1.04	.04
30.0	-.88	.00	-.04	-.01	-36.72	-64.58	.89	.03
35.0	-.81	-.06	-.03	-.00	-37.17	-59.37	.74	.03
40.0	-.70	-.07	-.02	.00	-37.96	-57.42	.65	.03
45.0	-.58	-.02	-.01	.01	-39.88	-60.24	.56	.02
50.0	-.42	.04	-.01	.00	-43.35	-62.10	.46	.01
55.0	-.27	.09	-.00	-.00	-49.00	-56.78	.31	.00
60.0	0.00	.05	0.00	-.00	-200.00	-54.19	.05	-.00
65.0	.26	-.01	-.01	-.01	-46.37	-59.06	-.27	.00
70.0	.52	-.08	-.04	-.00	-40.44	-56.77	-.60	.03
75.0	.79	-.05	-.08	.00	-36.24	-61.08	-.83	.08
80.0	.83	-.05	-.14	.01	-33.38	-55.47	-.88	.15
85.0	.73	.04	-.21	.01	-31.41	-58.59	-.69	.21
90.0	.38	.10	-.27	-.01	-30.83	-55.00	-.28	.26
95.0	-.21	.05	-.29	-.01	-31.45	-57.26	.25	.28
100.0	-.83	-.05	-.26	-.01	-31.91	-60.92	.78	.25
105.0	-1.27	-.10	-.18	.01	-33.07	-58.19	1.18	.19
110.0	-1.34	-.03	-.09	.01	-37.77	-62.86	1.31	.10
TOTAL	.78	.06	.13	.01	-54.06	-57.43		

NET REDUCTION OF MISMATCH ERROR= 22.97DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00350	-.00000
2	0.00000	0.00000	-.00457	.00000
3	0.00000	0.00000	.00988	.00000
4	0.00000	0.00000	-.00130	.00000
5	0.00000	0.00000	-.00026	-.00000
6	1.00000	0.00000	1.00160	-.00000
7	0.00000	0.00000	-.00715	.00000
8	0.00000	0.00000	-.00429	-.00000
9	0.00000	0.00000	-.00176	.00000
10	0.00000	0.00000	-.00188	-.00000
11	0.00000	0.00000	-.00066	.00000
12	0.00000	0.00000	-.00084	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 18 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.11	-.13	.05	-.00	-54.07	-52.95	.98	-.06
20.0	-.96	.05	.05	.00	-34.86	-60.62	1.01	-.05
25.0	-.81	.10	.05	.00	-36.33	-54.66	.91	-.05
30.0	-.74	.01	.04	-.00	-58.11	-66.24	.75	-.04
35.0	-.64	-.05	.04	-.00	-38.84	-61.68	.59	-.04
40.0	-.49	-.03	.03	-.00	-40.55	-65.16	.46	-.03
45.0	-.35	.01	.02	-.00	-43.46	-69.21	.36	-.03
50.0	-.34	-.06	.02	.00	-44.39	-59.43	.28	-.02
55.0	-.13	.05	.01	-.00	-52.75	-61.72	.18	-.01
60.0	0.00	.04	0.00	.00	-200.00	-60.83	.04	.00
65.0	.13	.02	-.03	-.00	-48.55	-67.78	-.11	.02
70.0	.22	-.03	-.05	-.00	-43.28	-64.17	-.25	.05
75.0	.25	-.04	-.08	.00	-40.41	-58.63	-.31	.09
80.0	.26	.00	-.13	-.00	-36.38	-79.52	-.26	.12
85.0	.11	.04	-.16	.00	-34.72	-62.91	-.07	.16
90.0	-.17	.04	-.19	-.01	-34.05	-60.83	.21	.18
95.0	-.61	-.08	-.18	.00	-34.67	-58.97	.53	.18
100.0	-.78	.03	-.15	.00	-35.46	-67.66	.81	.15
105.0	-1.02	-.04	-.09	.00	-37.33	-65.14	.98	.09
110.0	-.93	.05	-.02	-.01	-41.51	-64.65	.98	.02
TOTAL	.61	.06	.09	.00	-37.00	-59.61		

NET REDUCTION OF MISMATCH ERROR= 22.60DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00405	-.00000
2	0.00000	0.00000	-.00917	-.00000
3	0.00000	0.00000	.01190	.00000
4	0.00000	0.00000	-.00229	-.00000
5	0.00000	0.00000	.00288	.00000
6	1.00000	0.00000	1.00315	-.00000
7	0.00000	0.00000	-.00247	.00000
8	0.00000	0.00000	-.00404	-.00000
9	0.00000	0.00000	.00063	.00000
10	0.00000	0.00000	-.00101	-.00000
11	0.00000	0.00000	-.00023	.00000
12	0.00000	0.00000	-.00019	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 19 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.61	-.02	-.02	.01	-39.52	-63.15	.60	.02
20.0	-.62	.03	-.02	-.00	-39.00	-63.02	.65	.02
25.0	-.63	.01	-.02	-.00	-39.07	-65.70	.64	.01
30.0	-.59	.01	-.01	-.00	-40.49	-74.69	.60	.01
35.0	-.60	-.05	-.01	-.00	-39.97	-62.40	.55	.01
40.0	-.53	-.02	.00	.00	-40.57	-63.50	.51	.00
45.0	-.45	.01	.00	.00	-42.17	-65.98	.46	-.00
50.0	-.37	-.00	.01	.00	-44.35	-82.36	.37	-.01
55.0	-.16	.06	.01	-.00	-51.05	-59.39	.23	-.01
60.0	0.00	.02	0.00	-.00	-200.00	-64.57	.02	-.00
65.0	.19	-.02	-.02	-.01	-47.46	-62.15	-.21	.02
70.0	.36	-.06	-.05	.00	-41.74	-59.58	-.43	.05
75.0	.50	-.04	-.09	.01	-37.80	-59.85	-.54	.10
80.0	.53	.03	-.14	.01	-34.45	-58.79	-.50	.15
85.0	.33	.04	-.20	-.00	-32.63	-62.57	-.29	.19
90.0	-.01	.06	-.22	-.01	-32.61	-56.58	.07	.21
95.0	-.53	-.01	-.20	-.00	-34.06	-69.14	.51	.19
100.0	-1.07	-.14	-.14	.00	-34.44	-54.19	.93	.14
105.0	-1.21	.01	-.04	.01	-36.91	-59.04	1.21	.05
110.0	-1.12	.15	.04	-.01	-39.71	-56.22	1.27	-.05
TOTAL	.61	.06	.09	.01	-36.87	-59.67		

NET REDUCTION OF MISMATCH ERROR= 22.79DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.01346	.00000
2	0.00000	0.00000	-.01485	-.00000
3	0.00000	0.00000	.03562	.00000
4	0.00000	0.00000	-.00304	.00000
5	0.00000	0.00000	-.02064	.00000
6	1.00000	0.00000	1.01060	-.00000
7	0.00000	0.00000	-.04708	-.00000
8	0.00000	0.00000	-.00855	-.00000
9	0.00000	0.00000	-.00986	.00000
10	0.00000	0.00000	-.00247	-.00000
11	0.00000	0.00000	-.00469	-.00000
12	0.00000	0.00000	-.00055	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 20 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-4.06	-.44	.46	.01	-21.07	-42.62	3.65	-.46
20.0	-3.57	.20	.45	-.00	-21.51	-49.04	3.76	-.45
25.0	-3.11	.29	.43	-.00	-22.55	-46.01	3.40	-.43
30.0	-2.62	.14	.39	-.01	-24.55	-52.34	2.75	-.40
35.0	-2.20	-.14	.35	.00	-25.35	-52.75	2.06	-.35
40.0	-1.69	-.20	.30	.01	-26.68	-48.82	1.49	-.29
45.0	-1.23	-.14	.23	.01	-29.22	-52.11	1.09	-.23
50.0	-.78	.04	.17	.01	-33.20	-61.34	.81	-.16
55.0	-.38	.15	.09	-.01	-39.04	-51.95	.53	-.09
60.0	0.00	.17	0.00	-.00	-200.00	-50.48	.17	-.00
65.0	.39	.10	-.12	-.01	-36.36	-52.54	-.28	.11
70.0	.61	-.10	-.25	-.01	-30.87	-54.97	-.71	.24
75.0	.67	-.26	-.34	.01	-27.40	-46.94	-.94	.40
80.0	.67	-.12	-.55	.01	-23.94	-51.37	-.79	.57
85.0	.23	.04	-.70	.01	-22.08	-58.22	-.19	.71
90.0	-.50	.22	-.82	-.01	-21.54	-48.58	.81	.81
95.0	-1.88	.16	-.85	-.01	-21.94	-51.65	2.03	.83
100.0	-3.12	.04	-.79	-.01	-22.02	-57.51	3.20	.79
105.0	-4.15	-.15	-.65	.01	-23.50	-53.84	4.00	.67
110.0	-4.66	-.53	-.50	.00	-26.11	-46.57	4.13	.50
TOTAL	2.34	.22	.46	.01	-23.84	-48.80		

NET REDUCTION OF MISMATCH ERROR= 24.96DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.30852	-.00000
2	0.00000	0.00000	-.17582	.00000
3	0.00000	0.00000	-.22721	-.00000
4	0.00000	0.00000	-.22615	.00000
5	0.00000	0.00000	.11007	-.00000
6	1.00000	0.00000	-.17456	.00000
7	0.00000	0.00000	-.16656	-.00000
8	0.00000	0.00000	-.22111	.00000
9	0.00000	0.00000	-.08914	-.00000
10	0.00000	0.00000	-.21837	.00000
11	0.00000	0.00000	.02582	-.00000
12	0.00000	0.00000	-.28801	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 21 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	217.45	47.61	-.35	-7.28	5.11	-2.45	-169.85	-0.93
20.0	66.77	33.39	-.86	-13.41	.56	-1.49	-33.38	-12.55
25.0	38.46	26.94	-.57	-5.24	-3.95	-4.96	-11.52	-4.67
30.0	-20.62	-20.78	-.09	-4.10	-9.80	-7.56	-.16	-4.01
35.0	-69.11	-44.83	-.36	-6.52	.52	-2.97	24.27	+0.16
40.0	-87.96	-21.20	-.83	-7.48	2.51	-4.03	66.76	-0.66
45.0	-237.62	-146.11	-.69	-5.48	4.48	5.30	91.51	-4.79
50.0	244.41	-18.83	.33	-4.59	4.00	-7.26	-263.24	-4.72
55.0	-65.37	-330.23	.03	-7.44	.11	-4.52	-270.87	-7.46
60.0	0.00	57.07	0.00	-12.88	-200.00	-.94	57.07	-12.88
65.0	-265.36	94.93	-.02	-15.14	3.09	.29	360.28	-14.57
70.0	215.25	201.51	.08	-16.54	5.17	.69	-13.74	-16.42
75.0	-40.79	38.78	-.04	-18.63	-3.73	-1.38	79.56	-18.59
80.0	-68.35	38.86	-.59	-6.38	.84	-2.48	107.21	-7.78
85.0	194.05	501.84	-.63	-4.01	5.76	-1.24	107.79	-3.38
90.0	-184.85	-79.10	.20	-2.20	5.46	.51	105.75	-2.40
95.0	-27.76	70.70	.92	-3.78	-7.49	-1.28	104.46	-4.70
100.0	-68.34	-310.96	1.89	-11.90	-.03	-3.51	-247.63	-13.70
105.0	-254.65	-8.26	3.48	-7.12	2.50	-8.46	246.39	-10.60
110.0	-196.00	52.24	5.23	1.45	3.14	-6.03	248.24	-3.78
TOTAL	156.56	141.49	1.79	4.03	2.91	-1.13		

NET REDUCTION OF MISMATCH ERROR= 4.05DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00647	-.00000
2	0.00000	0.00000	-.00980	.00000
3	0.00000	0.00000	.01266	-.00000
4	0.00000	0.00000	.00322	.00000
5	0.00000	0.00000	-.00745	-.00000
6	1.00000	0.00000	1.01266	.00000
7	0.00000	0.00000	-.01472	-.00000
8	0.00000	0.00000	-.00013	.00000
9	0.00000	0.00000	-.00345	-.00000
10	0.00000	0.00000	.00108	.00000
11	0.00000	0.00000	-.00116	-.00000
12	0.00000	0.00000	.00068	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 22 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.86	.03	.05	.01	-36.12	-55.38	.89	-.04
20.0	-.95	.03	.04	-.01	-35.10	-60.97	.98	-.05
25.0	-.95	.02	.04	-.01	-35.33	-58.44	.97	-.05
30.0	-.92	-.03	.03	-.02	-36.54	-55.30	.89	-.04
35.0	-.89	-.09	.03	.00	-36.39	-56.91	.80	-.03
40.0	-.75	-.04	.03	.01	-37.32	-56.64	.72	-.02
45.0	-.60	.04	.02	.01	-39.45	-55.94	.63	-.01
50.0	-.55	-.02	.02	.01	-40.82	-58.31	.52	-.01
55.0	-.26	.09	.01	-.01	-47.20	-55.71	.35	-.01
60.0	0.00	.09	0.00	-.01	-200.00	-54.71	.09	-.01
65.0	.26	.02	-.03	-.02	-44.49	-54.35	-.24	.02
70.0	.48	-.10	-.08	-.01	-38.78	-54.68	-.57	.07
75.0	.65	-.15	-.13	.01	-35.03	-51.08	-.80	.14
80.0	.80	-.03	-.22	.02	-30.92	-53.84	-.83	.23
85.0	.64	.05	-.30	.02	-28.85	-53.53	-.59	.32
90.0	.25	.15	-.39	-.01	-27.83	-51.55	-.10	.38
95.0	-.52	.04	-.43	-.02	-28.04	-54.05	.56	.41
100.0	-1.19	.04	-.41	-.02	-28.05	-54.90	1.23	.39
105.0	-1.86	-.15	-.35	.00	-24.50	-55.23	1.72	.35
110.0	-2.09	-.23	-.25	.03	-32.65	-50.87	1.86	.28
TOTAL	.92	.09	.20	.01	-32.02	-53.80		

NET REDUCTION OF MISMATCH ERROR= 21.79DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00448	-.00000
2	0.00000	0.00000	-.00744	.00000
3	0.00000	0.00000	.00741	-.00000
4	0.00000	0.00000	.00809	.00000
5	0.00000	0.00000	.00203	-.00000
6	1.00000	0.00000	1.01259	.00000
7	0.00000	0.00000	.00186	-.00000
8	0.00000	0.00000	-.00248	.00000
9	0.00000	0.00000	.00062	.00000
10	0.00000	0.00000	-.00009	-.00000
11	0.00000	0.00000	.00028	.00000
12	0.00000	0.00000	.00012	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 23 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.47	.09	-.18	.01	-33.53	-54.02	.56	.19
20.0	-.64	.01	-.17	-.01	-32.92	-63.45	.65	.16
25.0	-.74	-.03	-.15	-.01	-33.35	-57.51	.71	.14
30.0	-.78	-.05	-.13	-.01	-34.70	-59.50	.73	.13
35.0	-.80	-.06	-.11	.00	-35.02	-60.23	.74	.11
40.0	-.74	-.02	-.08	.01	-35.83	-61.20	.72	.09
45.0	-.63	.03	-.06	.01	-37.86	-57.69	.66	.07
50.0	-.48	.06	-.04	.00	-41.32	-59.58	.54	.04
55.0	-.25	.07	-.02	-.00	-46.91	-58.69	.32	.01
60.0	0.00	.01	0.00	-.01	-200.00	-62.14	.01	-.01
65.0	.31	-.04	-.00	-.01	-45.16	-56.12	-.36	-.01
70.0	.64	-.08	-.02	-.00	-39.36	-56.57	-.73	.01
75.0	.99	-.02	-.05	.01	-35.35	-64.01	-1.01	.06
80.0	1.11	-.01	-.10	.02	-32.84	-54.87	-1.13	.12
85.0	1.16	.05	-.17	.01	-31.27	-57.14	-1.04	.18
90.0	.85	.09	-.23	-.01	-31.20	-55.82	-.77	.22
95.0	.37	.01	-.25	-.02	-32.50	-56.49	-.36	.23
100.0	-.17	-.09	-.22	-.01	-33.98	-56.62	.09	.21
105.0	-.54	-.09	-.16	.01	-37.43	-58.86	.45	.16
110.0	-.56	.09	-.07	.02	-43.79	-57.24	.64	.09
TOTAL	.67	.06	.13	.01	-34.38	-56.98		

NET REDUCTION OF MISMATCH ERROR=   22.60DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.01010	-.00000
2	0.00000	0.00000	-.01531	.00000
3	0.00000	0.00000	.01614	-.00000
4	0.00000	0.00000	.01215	-.00000
5	0.00000	0.00000	-.00856	.00000
6	1.00000	0.00000	1.02678	-.00000
7	0.00000	0.00000	-.01485	.00000
8	0.00000	0.00000	.00286	-.00000
9	0.00000	0.00000	-.00390	.00000
10	0.00000	0.00000	.00310	-.00000
11	0.00000	0.00000	-.00136	.00000
12	0.00000	0.00000	.00166	-.00000
				.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 24 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.89	.13	-.12	.03	-34.10	-48.18	1.02	.14
20.0	-1.13	.05	-.11	-.01	-32.48	-56.00	1.17	.10
25.0	-1.26	-.02	-.10	-.02	-32.25	-51.06	1.23	.08
30.0	-1.31	-.08	-.09	-.03	-32.83	-50.64	1.23	.07
35.0	-1.31	-.12	-.07	.00	-32.76	-53.91	1.19	.07
40.0	-1.19	-.06	-.05	.02	-33.30	-51.45	1.13	.07
45.0	-1.00	.05	-.03	.03	-35.09	-50.30	1.05	.07
50.0	-.88	.02	-.01	.02	-37.04	-53.75	.89	.06
55.0	-.46	.14	-.00	-.01	-42.43	-51.95	.60	.03
60.0	0.00	.15	0.00	-.02	-200.00	-48.75	.15	-.01
65.0	.43	-.01	-.03	-.03	-41.79	-49.43	-.44	-.02
70.0	.90	-.15	-.08	-.01	-35.35	-50.61	-1.05	-.00
75.0	1.27	-.26	-.15	.02	-31.58	-46.59	-1.53	.06
80.0	1.61	-.08	-.27	.03	-27.50	-47.64	-1.69	.17
85.0	1.54	.12	-.41	.03	-25.34	-48.00	-1.42	.31
90.0	.99	.25	-.56	-.01	-24.48	-47.38	-.74	.44
95.0	-.13	.11	-.64	-.04	-24.73	-47.52	.24	.54
100.0	-1.25	.02	-.64	-.04	-24.74	-48.76	1.27	.60
105.0	-2.32	-.23	-.55	.01	-26.31	-51.15	2.09	.60
110.0	-2.86	-.44	-.41	.02	-29.31	-44.98	2.42	.55
TOTAL	1.31	.16	.30	.03	-28.67	-48.48		.47

NET REDUCTION OF MISMATCH ERROR= 19.81DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00388	-.00000
2	0.00000	0.00000	-.00740	.00000
3	0.00000	0.00000	.00596	-.00000
4	0.00000	0.00000	.00654	.00000
5	0.00000	0.00000	.00058	-.00000
6	1.00000	0.00000	1.01003	.00000
7	0.00000	0.00000	.00178	-.00000
8	0.00000	0.00000	-.00275	.00000
9	0.00000	0.00000	.00102	-.00000
10	0.00000	0.00000	.00003	.00000
11	0.00000	0.00000	.00050	-.00000
12	0.00000	0.00000	.00019	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 25 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.22	.12	-.13	.01	-36.76	-52.35	.34	.14
20.0	-.41	.01	-.13	-.01	-35.75	-63.93	.42	.12
25.0	-.56	-.07	-.12	-.01	-35.60	-55.16	.49	.11
30.0	-.58	-.04	-.10	-.01	-35.96	-60.58	.54	.10
35.0	-.64	-.05	-.09	.00	-36.87	-61.04	.58	.09
40.0	-.61	-.01	-.07	.01	-37.44	-61.46	.60	.08
45.0	-.53	.04	-.05	.01	-39.27	-57.28	.57	.06
50.0	-.42	.06	-.03	.00	-42.45	-60.11	.47	.04
55.0	-.22	.06	-.01	-.00	-48.08	-59.78	.28	.01
60.0	0.00	.01	0.00	-.01	-200.00	-61.34	.01	-.01
65.0	.29	-.05	-.00	-.01	-46.01	-56.36	-.33	-.01
70.0	.58	-.08	-.01	-.01	-40.22	-56.45	-.67	.01
75.0	.92	-.02	-.04	.01	-36.17	-62.55	-.93	.05
80.0	1.06	.00	-.09	.01	-33.51	-55.58	-1.06	.10
85.0	1.05	.05	-.14	.01	-32.06	-57.12	-1.00	.15
90.0	.85	.08	-.20	-.01	-32.01	-56.28	-.77	.19
95.0	.42	-.00	-.22	-.02	-33.46	-56.78	-.42	.20
100.0	-.06	-.09	-.20	-.01	-35.19	-56.36	-.03	.19
105.0	-.38	-.09	-.13	.01	-39.13	-59.40	.30	.14
110.0	-.37	.11	-.05	.02	-46.83	-56.41	.48	.07
TOTAL	.58	.06	.11	.01	-35.82	-56.72		

NET REDUCTION OF MISMATCH ERRORS   20.91DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00472	.00000
2	0.00000	0.00000	-.00801	.00000
3	0.00000	0.00000	.01022	.00000
4	0.00000	0.00000	.00314	.00000
5	0.00000	0.00000	.00542	.00000
6	1.00000	0.00000	1.00864	.00000
7	0.00000	0.00000	.00174	.00000
8	0.00000	0.00000	-.00239	.00000
9	0.00000	0.00000	.00032	.00000
10	0.00000	0.00000	-.00060	.00000
11	0.00000	0.00000	.00003	.00000
12	0.00000	0.00000	-.00014	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 26 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.65	-.02	-.15	.01	-33.89	-63.62	.63	.16
20.0	-.66	.04	-.14	-.00	-34.02	-63.82	.70	.14
25.0	-.65	.05	-.12	-.00	-34.98	-61.40	.70	.12
30.0	-.70	-.03	-.11	-.01	-35.76	-57.70	.67	.10
35.0	-.70	-.07	-.09	-.00	-36.36	-59.02	.63	.09
40.0	-.63	-.03	-.07	.01	-37.34	-60.64	.60	.07
45.0	-.51	.04	-.05	.01	-39.57	-60.52	.55	.06
50.0	-.47	-.01	-.02	.01	-41.93	-60.89	.46	.03
55.0	-.25	.05	-.02	-.00	-47.20	-59.73	.30	.01
60.0	0.00	.06	0.00	-.00	-200.00	-59.53	.06	-.00
65.0	.24	.00	-.01	-.01	-47.23	-58.70	-.24	-.00
70.0	.43	-.09	-.03	-.01	-42.31	-55.44	-.53	.02
75.0	.64	-.09	-.05	.01	-38.58	-55.25	-.73	.06
80.0	.77	.01	-.10	.01	-34.80	-60.14	-.76	.11
85.0	.68	.07	-.15	.01	-33.41	-55.94	-.61	.16
90.0	.37	.09	-.20	-.01	-33.06	-54.98	-.27	.19
95.0	-.23	-.07	-.20	-.01	-34.37	-57.93	.16	.19
100.0	-.62	-.02	-.16	-.01	-35.47	-63.04	.60	.16
105.0	-1.01	-.08	-.08	.01	-37.60	-59.61	.93	.09
110.0	-1.00	.05	.02	.01	-40.92	-62.04	1.05	-.01
TOTAL	.61	.06	.11	.01	-35.89	-58.02		

NET REDUCTION OF MISMATCH ERROR 22.12DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00511	-.00000
2	0.00000	0.00000	-.00781	.00000
3	0.00000	0.00000	.00879	-.00000
4	0.00000	0.00000	.00541	.00000
5	0.00000	0.00000	-.00427	-.00000
6	1.00000	0.00000	1.01062	.00000
7	0.00000	0.00000	-.00670	-.00000
8	0.00000	0.00000	-.00165	.00000
9	0.00000	0.00000	-.00154	-.00000
10	0.00000	0.00000	.00043	.00000
11	0.00000	0.00000	-.00043	-.00000
12	0.00000	0.00000	.00050	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 27 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.62	.06	-.02	.01	-39.37	-55.03	.68	.04
20.0	-.73	.03	-.03	-.01	-37.55	-62.19	.75	.02
25.0	-.78	-.02	-.05	-.01	-37.10	-56.85	.76	.02
30.0	-.76	-.04	-.02	-.01	-38.17	-59.76	.72	.02
35.0	-.73	-.05	-.02	.00	-38.18	-60.64	.67	.02
40.0	-.65	-.03	-.01	.01	-38.75	-58.87	.62	.02
45.0	-.54	.01	-.01	.01	-40.49	-57.12	.56	.02
50.0	-.40	.06	-.00	.00	-43.91	-59.52	.45	.01
55.0	-.20	.08	.00	-.00	-49.50	-57.95	.28	-.00
60.0	0.00	.02	0.00	-.01	-200.00	-58.46	.02	-.01
65.0	.20	-.02	-.01	-.01	-45.63	-56.65	-.30	.00
70.0	.54	-.09	-.04	-.01	-40.13	-55.96	-.63	.03
75.0	.83	-.04	-.08	.01	-35.88	-59.80	-.88	.09
80.0	.93	-.03	-.14	.02	-32.81	-54.42	-.96	.15
85.0	.84	.04	-.21	.01	-30.84	-57.18	-.82	.22
90.0	.58	.10	-.28	-.01	-30.24	-54.71	-.48	.27
95.0	.05	.05	-.31	-.02	-30.83	-55.32	.00	.29
100.0	-.55	-.04	-.30	-.01	-31.25	-57.49	.51	.29
105.0	-1.01	-.10	-.24	.00	-33.31	-58.20	.91	.24
110.0	-1.14	-.07	-.16	.03	-37.27	-55.66	1.07	.18
TOTAL	.68	.06	.14	.01	-34.56	-56.45		

NET REDUCTION OF MISMATCH ERROR= 21.870B.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00533	-.00000
2	0.00000	0.00000	-.00977	-.00000
3	0.00000	0.00000	.00986	-.00000
4	0.00000	0.00000	.00157	-.00000
5	0.00000	0.00000	-.00586	-.00000
6	1.00000	0.00000	1.01123	.00000
7	0.00000	0.00000	-.00946	-.00000
8	0.00000	0.00000	.00027	.00000
9	0.00000	0.00000	-.00173	-.00000
10	0.00000	0.00000	.00062	-.00000
11	0.00000	0.00000	-.00061	-.00000
12	0.00000	0.00000	.00042	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 28 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES) BEFORE	AFTER	AMPLITUDE ERROR (DB) BEFORE	AFTER	TOTAL MS ERROR (DB POWER) BEFORE	AFTER	FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
15.0	-.47	-.03	.01	.01	-41.82	-60.26	.44	-.00
20.0	-.35	.13	.02	.01	-43.76	-51.92	.48	-.01
25.0	-.47	.02	-.01	-.02	-41.77	-54.81	.49	-.01
30.0	-.60	-.12	-.02	-.02	-40.26	-51.01	.48	.00
35.0	-.59	-.12	-.01	-.00	-40.11	-53.98	.47	.01
40.0	-.45	.01	.00	.02	-42.02	-52.85	.46	.02
45.0	-.40	.05	-.00	.01	-43.14	-55.91	.45	.01
50.0	-.37	.02	.00	.01	-44.42	-62.20	.39	.00
55.0	-.18	.08	-.00	-.01	-50.64	-56.66	.26	-.01
60.0	0.00	.03	0.00	-.01	-200.00	-60.05	.05	-.01
65.0	.26	-.01	-.03	-.02	-44.96	-52.89	-.27	.01
70.0	.50	-.07	-.06	-.00	-39.74	-57.75	-.57	.05
75.0	.70	-.07	-.10	.02	-36.03	-53.70	-.77	.12
80.0	.76	-.03	-.18	.02	-32.12	-54.79	-.79	.20
85.0	.63	.05	-.26	.01	-29.99	-55.62	-.58	.27
90.0	.25	.09	-.33	-.01	-29.07	-54.52	-.15	.32
95.0	-.45	-.04	-.37	-.02	-29.31	-53.74	.41	.35
100.0	-.84	.14	-.34	-.01	-29.90	-53.48	.98	.33
105.0	-1.51	-.11	-.27	.01	-31.44	-56.80	1.40	.28
110.0	-1.80	-.27	-.19	.02	-34.28	-51.19	1.52	.21
TOTAL	.71	.10	.17	.01	-33.84	-53.69		

NET REDUCTION OF MISMATCH ERROR= 19.8508.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00640	.00000
2	0.00000	0.00000	-.00484	-.00000
3	0.00000	0.00000	.00830	.00000
4	0.00000	0.00000	.01468	-.00000
5	0.00000	0.00000	-.00223	.00000
6	1.00000	0.00000	1.02094	-.00000
7	0.00000	0.00000	-.00049	.00000
8	0.00000	0.00000	-.00080	-.00000
9	0.00000	0.00000	-.00021	.00000
10	0.00000	0.00000	.00109	-.00000
11	0.00000	0.00000	-.00007	.00000
12	0.00000	0.00000	.00060	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 29 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.59	.12	-.23	.02	-31.41	-50.81	.70	.25
20.0	-.81	.02	-.21	-.01	-30.90	-60.61	.83	.21
25.0	-.93	-.03	-.19	-.02	-31.32	-53.46	.90	.18
30.0	-1.00	-.06	-.17	-.01	-32.66	-55.76	.93	.15
35.0	-1.03	-.08	-.14	-.00	-32.91	-57.02	.94	.12
40.0	-.96	-.03	-.10	.01	-33.72	-56.47	.93	.09
45.0	-.82	.05	-.07	.02	-35.76	-53.10	.87	.05
50.0	-.73	-.01	-.04	.01	-37.04	-60.16	.73	.01
55.0	-.53	.13	-.02	-.00	-44.95	-53.28	.46	.01
60.0	0.00	.06	0.00	-.01	-200.00	-54.40	.06	-.01
65.0	.43	-.02	-.00	-.02	-42.38	-53.23	-.45	-.02
70.0	.91	-.07	-.02	-.01	-36.33	-55.80	-.94	.01
75.0	1.24	-.19	-.07	.01	-33.37	-50.05	-1.43	.08
80.0	1.63	.02	-.11	.02	-29.70	-51.03	-1.65	.16
85.0	1.68	.09	-.25	.02	-27.48	-51.99	-1.60	.25
90.0	1.41	.15	-.35	-.01	-27.60	-51.78	-1.26	.33
95.0	.77	.07	-.34	-.03	-28.47	-51.06	-.70	.37
100.0	.03	-.04	-.39	-.02	-29.23	-52.91	-.07	.37
105.0	-.64	-.17	-.33	.00	-31.80	-53.99	.47	.33
110.0	-.91	-.12	-.23	.04	-36.22	-50.90	.79	.27
TOTAL	.95	.09	.20	.02	-31.24	-52.42		

NET REDUCTION OF MISMATCH ERROR= 21.18DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00658	-.00000
2	0.00000	0.00000	-.01016	-.00000
3	0.00000	0.00000	.01289	-.00000
4	0.00000	0.00000	.00769	-.00000
5	0.00000	0.00000	-.00471	.00000
6	1.00000	0.00000	1.01505	.00000
7	0.00000	0.00000	-.00940	-.00000
8	0.00000	0.00000	-.00243	.00000
9	0.00000	0.00000	-.00137	-.00000
10	0.00000	0.00000	.00007	.00000
11	0.00000	0.00000	-.00068	-.00000
12	0.00000	0.00000	.00046	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 30 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.02	.02	-.05	.01	-54.82	-55.91	1.04	.07
20.0	-1.13	.04	-.05	-.01	-33.66	-60.44	1.16	.05
25.0	-1.18	.04	-.04	-.01	-33.87	-56.72	1.18	.03
30.0	-1.18	-.08	-.04	-.01	-34.35	-55.48	1.13	.03
35.0	-1.12	-.09	-.05	.00	-34.46	-56.81	1.04	.03
40.0	-.90	-.05	-.01	.01	-35.18	-56.49	.94	.02
45.0	-.78	.04	-.01	.01	-37.32	-56.69	.83	.02
50.0	-.65	.01	.01	.01	-39.55	-57.87	.67	.02
55.0	-.34	.08	.00	-.01	-45.07	-56.59	.42	.00
60.0	0.00	.07	0.00	-.01	-200.00	-55.47	.07	-.01
65.0	.36	.01	-.03	-.02	-42.99	-54.46	-.35	.01
70.0	.67	-.11	-.07	-.01	-37.47	-54.01	-.78	.06
75.0	.97	-.13	-.13	.01	-33.63	-52.17	-1.10	.14
80.0	1.18	-.03	-.21	.02	-29.90	-53.47	-1.21	.23
85.0	1.11	.08	-.30	.01	-28.00	-53.40	-1.04	.32
90.0	.75	.14	-.39	-.01	-27.40	-51.54	-.60	.38
95.0	-.00	.00	-.42	-.02	-28.25	-55.05	.01	.40
100.0	-.65	.00	-.40	-.02	-28.83	-57.10	.66	.38
105.0	-1.30	-.13	-.52	.01	-31.00	-55.86	1.17	.32
110.0	-1.51	-.13	-.21	.03	-34.81	-53.94	1.38	.24
TOTAL	.93	.08	.19	.01	-51.70	-54.33		

NET REDUCTION OF MISMATCH ERROR= 22.63DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.28582	-.00000
2	0.00000	0.00000	-.17060	.00000
3	0.00000	0.00000	-.21258	-.00 in
4	0.00000	0.00000	-.21714	.00600
5	0.00000	0.00000	.10214	-.00000
6	1.00000	0.00000	-.16284	.00000
7	0.00000	0.00000	-.15594	-.00000
8	0.00000	0.00000	-.20606	.00000
9	0.00000	0.00000	-.08553	-.00000
10	0.00000	0.00000	-.21014	.00000
11	0.00000	0.00000	.02116	-.00000
12	0.00000	0.00000	-.26648	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 31 WITH 12 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	218.54	49.26	.19	-7.22	5.36	-2.53	-169.28	-7.41
20.0	67.16	32.53	-.20	-15.14	.91	-1.56	-34.63	-12.44
25.0	39.64	27.37	.01	-5.12	-3.43	-4.98	-17.27	-5.12
30.0	-18.64	-19.83	.75	-5.69	-9.96	-7.88	-1.19	-4.44
35.0	-66.71	-44.46	.20	-6.56	.56	-5.04	22.25	-6.62
40.0	-87.24	-22.47	-.13	-7.51	2.78	-3.94	64.77	-7.39
45.0	-238.85	-147.94	.00	-5.55	4.76	3.31	90.91	-5.55
50.0	244.41	-18.67	.61	-4.80	4.15	-6.92	-263.08	-5.41
55.0	-65.45	-335.38	.56	-7.51	.40	-4.42	-269.91	-8.08
60.0	0.00	59.86	0.00	-13.53	-200.00	-.79	59.86	-13.53
65.0	-265.22	97.09	-.01	-15.59	3.39	.34	362.91	-15.57
70.0	215.34	204.58	.52	-16.80	5.39	.61	-10.76	-17.32
75.0	-40.46	37.78	.00	-18.10	-3.44	-1.44	78.23	-14.70
80.0	-67.53	38.07	-.03	-8.44	1.01	-2.51	105.60	-8.41
85.0	194.21	300.76	-.17	-4.22	3.04	-1.14	106.54	-4.07
90.0	-184.19	-74.57	.69	-2.40	5.71	.49	104.61	-3.09
95.0	-27.51	75.77	1.81	-5.58	-6.56	-1.31	103.28	-5.59
100.0	-68.10	-312.44	2.16	-12.32	.12	-3.51	-244.33	-14.49
105.0	-254.87	-9.14	3.69	-7.63	2.63	-8.07	245.73	-11.32
110.0	-194.80	52.44	5.89	1.46	3.58	-6.00	247.23	-4.43
TOTAL	156.55	141.69	2.03	4.05	3.16	-1.12		

NET REDUCTION OF MISMATCH ERROR=   4.2608.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00874	.00000
2	0.00000	0.00000	-.01343	-.00000
3	0.00000	0.00000	.01711	.00000
4	0.00000	0.00000	.01235	-.00000
5	0.00000	0.00000	-.00606	.00000
6	1.00000	0.00000	1.02447	-.00000
7	0.00000	0.00000	-.00828	-.00000
8	0.00000	0.00000	.00213	-.00000
9	0.00000	0.00000	-.00225	.00000
10	0.00000	0.00000	.00257	-.00000
11	0.00000	0.00000	-.00079	.00000
12	0.00000	0.00000	.00148	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 32 WITH 12 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.58	.13	-.16	.03	-33.77	-48.78	.72	.19
20.0	-.80	.04	-.16	-.01	-32.75	-57.55	.84	.15
25.0	-.92	-.01	-.14	-.02	-32.89	-52.12	.91	.12
30.0	-1.05	-.11	-.13	-.02	-33.29	-50.41	.94	.11
35.0	-1.06	-.11	-.11	.00	-33.44	-54.43	.95	.11
40.0	-.98	-.04	-.08	.02	-34.17	-52.81	.94	.10
45.0	-.83	.06	-.06	.02	-35.97	-51.14	.89	.08
50.0	-.75	.02	-.03	.02	-38.13	-54.46	.77	.05
55.0	-.30	.13	-.02	-.01	-43.58	-52.98	.52	.01
60.0	0.00	.11	0.00	-.02	200.00	-51.03	.11	-.02
65.0	.44	.01	-.01	-.03	-42.05	-49.86	-.43	-.01
70.0	.86	-.15	-.05	-.01	-36.35	-50.76	-1.01	.04
75.0	1.26	-.21	-.11	.02	-32.54	-48.08	-1.48	.13
80.0	1.62	-.06	-.21	.03	-28.57	-48.66	-1.67	.24
85.0	1.60	.10	-.33	.03	-26.56	-48.88	-1.50	.36
90.0	1.19	.23	-.46	-.01	-25.76	-47.99	-.96	.45
95.0	.23	.09	-.54	-.04	-24.22	-48.50	-.14	.50
100.0	-.74	.01	-.54	-.04	-26.43	-49.73	.74	.50
105.0	-1.70	-.23	-.45	.01	-28.21	-51.29	1.47	.46
110.0	-2.13	-.32	-.32	.06	-31.56	-46.54	1.81	.39
TOTAL	1.09	.14	.25	.03	-29.97	-49.44		

NET REDUCTION OF MISMATCH ERROR= 19.47DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00057	-.00000
2	0.00000	0.00000	-.00256	.00000
3	0.00000	0.00000	.00604	-.00000
4	0.00000	0.00000	-.01069	.00000
5	0.00000	0.00000	.00423	-.00000
6	0.00000	0.00000	.00678	.00000
7	0.00000	0.00000	-.00069	-.00000
8	1.00100	0.00000	1.01328	.00000
9	0.00000	0.00000	-.00247	-.00000
10	0.00000	0.00000	-.00313	.00000
11	0.00000	0.00000	.00041	-.00000
12	0.00000	0.00000	-.00085	.00000
13	0.00000	0.00000	.00043	-.00000
14	0.00000	0.00000	-.00023	.00000
15	0.00000	0.00000	.00024	-.00000
16	0.00000	0.00000	-.00013	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 2 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.44	.02	-.13	-.00	-35.40	-69.49	.50	.13
20.0	-.68	-.02	-.13	-.00	-34.24	-68.58	.60	.13
25.0	-.74	-.01	-.12	.00	-34.45	-66.26	.74	.12
30.0	-.86	.01	-.11	-.00	-35.02	-66.81	.87	.11
35.0	-.80	-.01	-.09	.00	-35.12	-77.93	.88	.09
40.0	-.81	.02	-.07	.00	-35.49	-67.64	.85	.07
45.0	-.68	.03	-.05	-.00	-37.70	-64.01	.71	.05
50.0	-.63	-.09	-.02	.00	-39.62	-56.41	.54	.03
55.0	-.34	-.01	-.02	-.00	-44.81	-66.72	.32	.01
60.0	0.00	.05	0.00	-.00	-200.00	-54.37	.05	.00
65.0	.30	.05	-.01	-.00	-45.52	-64.28	-.27	.01
70.0	.60	-.02	-.04	-.00	-39.44	-65.24	-.62	.03
75.0	.88	-.07	-.07	.00	-35.75	-58.40	-.95	.08
80.0	1.16	.01	-.14	.00	-31.66	-71.45	-1.15	.14
85.0	1.16	.02	-.22	.00	-29.48	-64.40	-1.13	.22
90.0	.91	.06	-.30	-.01	-29.26	-58.10	-.85	.29
95.0	.29	-.07	-.33	-.00	-30.16	-60.50	-.35	.33
100.0	-.27	-.02	-.33	.00	-30.73	-70.32	.25	.33
105.0	-.81	-.03	-.26	.01	-33.20	-65.18	.77	.27
110.0	-.96	.11	-.17	-.01	-37.66	-54.54	1.07	.16
TOTAL	.45	.01	.16	.00	-33.12	-61.60		

NET REDUCTION OF MISMATCH ERROR= 28.48DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00037	-.00000
2	0.00000	0.00000	-.00256	.00000
3	0.00000	0.00000	.00604	-.00000
4	0.00000	0.00000	-.01089	.00000
5	0.00000	0.00000	.00923	-.00000
6	0.00000	0.00000	.00678	.00000
7	0.00000	0.00000	-.00089	-.00000
8	1.00000	0.00000	1.01328	.00000
9	0.00000	0.00000	-.00247	-.00000
10	0.00000	0.00000	-.00313	.00000
11	0.00000	0.00000	.00041	-.00000
12	0.00000	0.00000	-.00085	.00000
13	0.00000	0.00000	.00043	-.00000
14	0.00000	0.00000	-.00023	.00000
15	0.00000	0.00000	.00024	-.00000
16	0.00000	0.00000	-.00013	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 2 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.48	.42	-.13	-.00	-35.40	-69.49	.50	.13
20.0	-.68	-.02	-.13	-.00	-34.29	-68.58	.66	.13
25.0	-.79	-.01	-.12	.00	-34.45	-66.26	.79	.13
30.0	-.86	.01	-.11	-.00	-35.02	-66.81	.79	.12
35.0	-.89	-.01	-.09	.00	-35.12	-77.93	.87	.11
40.0	-.81	.02	-.07	.00	-35.89	-67.64	.88	.09
45.0	-.68	.03	-.05	-.00	-37.76	-64.81	.83	.07
50.0	-.63	-.09	-.02	.00	-39.62	-56.41	.71	.05
55.0	-.34	-.01	-.02	-.00	-44.81	-66.72	.54	.03
60.0	0.00	.05	0.00	.00	-200.00	-59.37	.32	.01
65.0	.30	.03	-.01	-.00	-45.32	-64.28	.05	.00
70.0	.60	-.02	-.04	-.00	-39.44	-65.28	-.27	.01
75.0	.88	-.07	-.07	.00	-35.75	-58.40	-.62	.03
80.0	1.16	.01	-.14	.00	-31.66	-71.93	-.95	.08
85.0	1.15	.02	-.22	.00	-29.88	-64.90	-1.15	.14
90.0	.91	.06	-.30	-.01	-29.28	-58.70	-1.13	.22
95.0	.29	-.07	-.33	-.00	-30.16	-60.50	-.85	.29
100.0	-.27	-.07	-.33	.00	-30.73	-70.32	-.35	.33
105.0	-.81	-.05	-.26	.01	-33.26	-65.18	.25	.33
110.0	-.96	.11	-.17	-.01	-37.68	-59.54	.77	.27
TOTAL	.45	.01	.16	.00	-33.32	-61.80	1.07	.16

NET REDUCTION OF MISMATCH ERROR= 28.48DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00061	.00000
2	0.00000	0.00000	-.00357	-.00000
3	0.00000	0.00000	.00993	.00000
4	0.00000	0.00000	-.01650	-.00000
5	0.00000	0.00000	.01978	.00000
6	0.00000	0.00000	.00165	-.00000
7	0.00000	0.00000	-.00158	.00000
8	1.00000	0.00000	1.01424	-.00000
9	0.00000	0.00000	-.01159	.00000
10	0.00000	0.00000	-.00173	-.00000
11	0.00000	0.00000	-.00313	.00000
12	0.00000	0.00000	-.00040	-.00000
13	0.00000	0.00000	-.00111	.00000
14	0.00000	0.00000	-.00035	-.00000
15	0.00000	0.00000	-.00027	.00000
16	0.00000	0.00000	-.00024	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 3 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.10	-.02	-.07	-.00	-33.90	-69.55	1.08	.07
20.0	-1.19	.03	-.07	-.00	-32.96	-65.73	1.22	.07
25.0	-1.28	-.02	-.06	.00	-32.75	-66.40	1.26	.06
30.0	-1.22	.02	-.04	-.00	-34.11	-71.62	1.23	.04
35.0	-1.15	-.00	-.02	-.00	-34.27	-79.68	1.15	.02
40.0	-1.01	.00	-.01	-.00	-34.98	-71.18	1.02	.01
45.0	-.84	-.01	.00	.00	-36.69	-73.71	.83	-.00
50.0	-.61	-.01	.01	.00	-40.14	-68.93	.60	-.01
55.0	-.31	.01	.01	.00	-45.75	-72.03	.32	-.01
60.0	0.00	.01	0.00	.00	-200.00	-79.17	.01	.00
65.0	.36	.01	-.03	-.00	-43.09	-69.17	-.35	.02
70.0	.70	-.01	-.07	-.00	-37.05	-68.41	-.71	.07
75.0	.99	-.01	-.15	.00	-33.02	-71.47	-1.00	.15
80.0	1.07	-.01	-.24	.00	-29.46	-65.72	-1.08	.25
85.0	.85	.01	-.35	.00	-27.32	-69.23	-.84	.36
90.0	.26	.04	-.46	-.01	-26.46	-60.27	-.23	.45
95.0	-.69	-.01	-.50	-.00	-26.65	-67.15	.69	.49
100.0	-1.77	-.08	-.47	.00	-26.46	-59.37	1.70	.47
105.0	-2.51	.02	-.36	.01	-28.08	-59.94	2.53	.38
110.0	-2.81	.07	-.23	-.01	-31.01	-60.43	2.88	.22
TOTAL	1.24	.03	.25	.00	-30.39	-64.59		

NET REDUCTION OF MISMATCH ERROR=   34.20DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00019	-.00000
2	0.00000	0.00000	-.00072	-.00000
3	0.00000	0.00000	.00283	-.00000
4	0.00000	0.00000	-.00671	-.00000
5	0.00000	0.00000	.00779	-.00000
6	0.00000	0.00000	-.00287	-.00000
7	0.00000	0.00000	.00186	-.00000
8	1.00000	0.00000	1.00134	-.00000
9	0.00000	0.00000	-.00226	-.00000
10	0.00000	0.00000	-.00340	-.00000
11	0.00000	0.00000	.00031	-.00000
12	0.00000	0.00000	-.00107	-.00000
13	0.00000	0.00000	.00038	.00000
14	0.00000	0.00000	-.00042	-.00000
15	0.00000	0.00000	.00021	.00000
16	0.00000	0.00000	-.00017	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 4 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.28	.00	.01	-.00	-46.41	-76.74	.28	-.01
20.0	-.36	-.01	-.00	.00	-43.86	-78.61	.36	.00
25.0	-.41	.00	-.00	.00	-43.01	-67.42	.41	.00
30.0	-.43	.00	-.01	-.00	-43.24	-66.25	.43	.01
35.0	-.44	-.01	-.01	-.00	-42.67	-73.29	.43	.01
40.0	-.38	.02	-.01	.00	-43.53	-71.29	.39	.01
45.0	-.30	.04	-.01	-.00	-45.58	-64.25	.34	.00
50.0	-.35	-.09	.00	.00	-45.08	-56.88	.26	.00
55.0	-.17	-.00	-.00	-.00	-51.19	-68.06	.17	.00
60.0	0.00	.04	0.00	.00	-200.00	-61.64	.04	.00
65.0	.13	.03	-.02	-.00	-50.67	-64.78	-.10	.01
70.0	.23	-.02	-.04	-.00	-45.22	-65.46	-.25	.03
75.0	.28	-.07	-.06	.00	-42.27	-58.26	-.34	.06
80.0	.35	.01	-.10	.00	-37.81	-71.87	-.33	.10
85.0	.22	.03	-.13	.00	-36.30	-64.32	-.19	.13
90.0	-.04	.04	-.16	-.01	-35.63	-59.78	.09	.15
95.0	-.40	-.07	-.14	.00	-36.42	-59.99	.42	.14
100.0	-.73	-.01	-.11	.00	-37.24	-72.54	.72	.11
105.0	-.93	-.02	-.04	.01	-39.05	-66.20	.90	.04
110.0	-.83	.09	.04	-.01	-42.26	-61.29	.92	-.04
TOTAL	.43	.04	.07	.00	-40.03	-62.56		

NET REDUCTION OF MISMATCH ERROR= 22.53DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00109	-.00000
2	0.00000	0.00000	-.00301	-.00000
3	0.00000	0.00000	.00776	.00000
4	0.00000	0.00000	-.01023	-.00000
5	0.00000	0.00000	.01208	.00000
6	0.00000	0.00000	.00369	-.00000
7	0.00000	0.00000	-.01301	.00000
8	1.00000	0.00000	1.01122	-.00000
9	0.00000	0.00000	-.01981	.00000
10	0.00000	0.00000	-.00159	-.00000
11	0.00000	0.00000	-.00477	.00000
12	0.00000	0.00000	.00017	-.00000
13	0.00000	0.00000	-.00170	.00000
14	0.00000	0.00000	.00016	-.00000
15	0.00000	0.00000	-.00050	.00000
16	0.00000	0.00000	.00010	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 5 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.06	-.00	.14	.00	-32.38	-75.99	1.06	-.14
20.0	-1.14	.01	.12	-.00	-32.07	-70.33	1.15	-.12
25.0	-1.13	-.01	.11	-.00	-32.61	-75.38	1.12	-.11
30.0	-1.03	.00	.10	.00	-34.24	-72.93	1.03	-.10
35.0	-.92	-.00	.09	.00	-34.87	-76.82	.91	-.09
40.0	-.77	.00	.07	-.00	-35.89	-75.71	.78	-.07
45.0	-.61	.01	.06	-.00	-38.01	-72.59	.62	-.06
50.0	-.46	-.03	.04	-.00	-41.24	-67.57	.43	-.04
55.0	-.21	.01	.02	.00	-47.41	-72.50	.23	-.02
60.0	0.00	-.00	0.00	.00	-200.00	-69.28	-.00	.00
65.0	.25	.00	-.04	-.00	-44.46	-78.12	-.25	.03
70.0	.49	-.00	-.08	-.00	-38.52	-69.57	-.49	.08
75.0	.73	.02	-.14	-.00	-34.49	-70.61	-.71	.14
80.0	.80	-.02	-.22	.00	-30.86	-68.48	-.82	.22
85.0	.74	-.00	-.31	.00	-28.46	-70.77	-.75	.31
90.0	.43	.02	-.40	-.00	-27.39	-67.24	-.41	.40
95.0	-.20	.00	-.47	-.00	-27.36	-74.10	.20	.47
100.0	-.98	-.03	-.49	.00	-27.05	-69.35	.96	.49
105.0	-1.64	.01	-.45	.01	-28.34	-67.68	1.65	.45
110.0	-2.01	.01	-.38	-.00	-31.01	-71.72	2.02	.38
TOTAL	.92	.01	.24	.00	-30.98	-70.09		

NET REDUCTION OF MISMATCH ERROR= 39.11DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00177	.00000
2	0.00000	0.00000	-.00318	-.00000
3	0.00000	0.00000	.01002	.00000
4	0.00000	0.00000	-.01222	-.00000
5	0.00000	0.00000	.01618	.00000
6	0.00000	0.00000	.00604	-.00000
7	0.00000	0.00000	-.00947	.00000
8	1.00000	0.00000	1.01488	-.00000
9	0.00000	0.00000	-.01858	.00000
10	0.00000	0.00000	-.00319	-.00000
11	0.00000	0.00000	-.00472	.00000
12	0.00000	0.00000	-.00124	-.00000
13	0.00000	0.00000	-.00191	.00000
14	0.00000	0.00000	-.00067	-.00000
15	0.00000	0.00000	-.00065	.00000
16	0.00000	0.00000	-.00039	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 6 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.67	-.05	.04	-.00	-30.81	-61.28	1.62	-.04
20.0	-1.59	.05	.04	.00	-30.83	-61.49	1.64	-.04
25.0	-1.48	.03	.04	.00	-31.63	-63.49	1.51	-.04
30.0	-1.37	-.03	.03	-.01	-33.13	-62.52	1.34	-.04
35.0	-1.24	-.05	.04	-.00	-33.47	-61.77	1.20	-.04
40.0	-1.04	.01	.04	.00	-34.53	-70.94	1.05	-.04
45.0	-.80	.06	.03	-.00	-36.81	-59.04	.87	-.03
50.0	-.60	-.06	.03	.00	-38.75	-59.09	.62	-.03
55.0	-.34	-.01	.01	-.00	-44.86	-68.42	.33	-.02
60.0	0.00	.02	0.00	.00	-200.00	-66.37	.02	.00
65.0	.32	.02	-.04	-.00	-42.93	-66.73	-.30	.04
70.0	.60	-.01	-.09	-.00	-37.13	-65.83	-.61	.09
75.0	.83	-.05	-.15	.00	-33.45	-61.12	-.88	.16
80.0	1.06	.02	-.25	.00	-29.37	-67.67	-1.03	.25
85.0	.96	.01	-.35	.00	-27.22	-67.65	-.95	.35
90.0	.50	.04	-.46	-.01	-26.22	-60.58	-.55	.45
95.0	-.23	-.07	-.53	-.00	-26.35	-59.45	.16	.53
100.0	-1.03	.02	-.54	.00	-26.22	-68.51	1.04	.54
105.0	-1.86	-.01	-.48	.01	-27.63	-63.22	1.84	.49
110.0	-2.23	.03	-.39	-.01	-30.58	-63.76	2.26	.38
TOTAL	1.15	.04	.25	.00	-29.01	-62.03		

NET REDUCTION OF MISMATCH ERROR= 32.12DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00047	-.00000
2	0.00000	0.00000	-.00352	-.00000
3	0.00000	0.00000	.00981	-.00000
4	0.00000	0.00000	-.01703	-.00000
5	0.00000	0.00000	.01924	-.00000
6	0.00000	0.00000	-.00056	-.00000
7	0.00000	0.00000	-.00156	.00000
8	1.00000	0.00000	1.01255	-.00000
9	0.00000	0.00000	-.01054	-.00000
10	0.00000	0.00000	-.00164	-.00000
11	0.00000	0.00000	-.00258	-.00000
12	0.00000	0.00000	-.00015	-.00000
13	0.00000	0.00000	-.00088	-.00000
14	0.00000	0.00000	-.00016	-.00000
15	0.00000	0.00000	-.00019	-.00000
16	0.00000	0.00000	-.00012	-.00000

CORRECTION FILTER FOR RECEIVERS   1 AND   7 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.85	-.00	-.05	-.00	-36.34	-84.42	.85	.05
20.0	-.99	-.00	-.05	-.00	-34.75	-88.85	.98	.05
25.0	-1.06	-.01	-.04	.00	-34.49	-75.97	1.05	.04
30.0	-1.03	.03	-.03	.00	-35.70	-65.68	1.05	.03
35.0	-.99	-.00	-.02	-.00	-35.55	-75.19	.99	.02
40.0	-.91	-.02	-.01	-.00	-35.95	-67.89	.89	.01
45.0	-.74	-.00	-.00	.00	-37.80	-81.53	.74	.00
50.0	-.55	-.00	.01	.00	-41.05	-71.96	.55	-.00
55.0	-.29	.02	.01	.00	-46.51	-70.19	.30	-.01
60.0	0.00	.01	0.00	.00	-200.00	-73.06	.01	.00
65.0	.34	.00	-.03	-.00	-43.54	-69.99	-.34	.02
70.0	.67	-.03	-.07	-.00	-37.31	-63.54	-.70	.07
75.0	.99	.01	-.14	.00	-33.14	-71.33	-.98	.14
80.0	1.04	-.01	-.24	.01	-29.71	-63.63	-1.05	.24
85.0	.79	.00	-.35	.00	-27.52	-72.44	-.79	.35
90.0	.20	.04	-.44	-.01	-26.69	-60.95	-.16	.44
95.0	-.77	-.02	-.49	-.01	-26.83	-63.35	.75	.48
100.0	-1.81	-.04	-.45	.00	-26.78	-63.00	1.76	.45
105.0	-2.60	-.01	-.33	.01	-28.24	-60.22	2.59	.34
110.0	-2.86	.07	-.19	-.01	-31.17	-59.75	2.93	.18
TOTAL	1.26	.02	.21	.01	-30.83	-64.85		

NET REDUCTION OF MISMATCH ERRORS   34.02DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00036	-.00000
2	0.00000	0.00000	.00066	-.00000
3	0.00000	0.00000	0.00000	.00000
4	0.00000	0.00000	-.00206	-.00000
5	0.00000	0.00000	.00385	.00000
6	0.00000	0.00000	.00214	-.00000
7	0.00000	0.00000	.00626	.00000
8	1.00000	0.00000	1.00025	-.00000
9	0.00000	0.00000	.00562	.00000
10	0.00000	0.00000	-.00662	-.00000
11	0.00000	0.00000	.00208	.00000
12	0.00000	0.00000	-.00289	-.00000
13	0.00000	0.00000	.00068	.00000
14	0.00000	0.00000	-.00133	-.00000
15	0.00000	0.00000	.00028	.00000
16	0.00000	0.00000	-.00057	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 8 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES) BEFORE	AFTER	AMPLITUDE ERROR (DB) BEFORE	AFTER	TOTAL MS ERROR (DB POWER) BEFORE	AFTER	FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
15.0	-.50	-.04	-.19	-.00	-56.68	-62.91	.55	.09
20.0	-.55	.03	-.09	.00	-57.01	-64.08	.58	.09
25.0	-.53	.03	-.08	.01	-58.00	-61.90	.56	.08
30.0	-.56	-.03	-.08	-.01	-58.53	-61.25	.52	.07
35.0	-.52	-.03	-.06	-.00	-59.21	-64.67	.49	.06
40.0	-.43	.02	-.05	.00	-40.53	-70.01	.45	.05
45.0	-.34	.05	-.04	.00	-42.71	-62.00	.38	.04
50.0	-.37	-.07	-.02	.01	-44.04	-57.34	.29	.03
55.0	-.18	-.01	-.02	-.00	-49.22	-67.07	.18	.01
60.0	0.00	.04	0.00	-.00	-200.00	-63.52	.04	.00
65.0	.15	.03	-.00	-.00	-51.70	-62.60	-.12	-.00
70.0	.25	-.02	-.01	-.00	-47.54	-66.00	-.27	.01
75.0	.33	-.06	-.01	.01	-45.18	-58.42	-.39	.02
80.0	.43	.00	-.03	.00	-41.69	-74.77	-.43	.03
85.0	.42	.03	-.03	.00	-41.53	-64.52	-.39	.03
90.0	.36	.06	-.04	-.01	-43.07	-57.66	-.31	.03
95.0	.18	-.07	-.01	.00	-51.73	-59.95	-.25	.01
100.0	.24	-.01	.03	.00	-47.29	-66.98	-.20	-.03
105.0	.27	-.06	.08	.01	-43.15	-61.39	-.33	-.07
110.0	.56	.15	.13	-.01	-40.88	-56.97	-.41	-.14
TOTAL	.40	.05	.06	.00	-40.79	-60.83		

NET REDUCTION OF MISMATCH ERRORS = 20.04DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00051	-.00000
2	0.00000	0.00000	-.00338	.00000
3	0.00000	0.00000	.00785	-.00000
4	0.00000	0.00000	-.01298	.00000
5	0.00000	0.00000	.01102	-.00000
6	0.00000	0.00000	.00432	-.00000
7	0.00000	0.00000	-.00740	-.00000
8	1.00000	0.00000	1.01335	.00000
9	0.00000	0.00000	-.01074	-.00000
10	0.00000	0.00000	-.00136	.00000
11	0.00000	0.00000	-.00221	-.00000
12	0.00000	0.00000	.00025	.00000
13	0.00000	0.00000	-.00065	-.00000
14	0.00000	0.00000	.00016	-.00000
15	0.00000	0.00000	-.00002	-.00000
16	0.00000	0.00000	.00012	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 9 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.55	.03	-.01	.00	-40.61	-66.60	.57	.01
20.0	-.75	-.02	-.02	-.00	-37.42	-65.54	.73	.02
25.0	-.85	-.02	-.02	.00	-36.59	-68.62	.83	.02
30.0	-.83	.03	-.02	.00	-37.52	-66.91	.86	.02
35.0	-.81	.01	-.01	.00	-37.33	-71.54	.83	.01
40.0	-.74	-.00	-.01	-.00	-37.68	-77.18	.74	.01
45.0	-.63	-.01	-.00	-.00	-39.30	-73.97	.62	-.00
50.0	-.48	-.02	.00	-.00	-42.23	-67.97	.46	-.00
55.0	-.24	.02	.00	.00	-48.18	-68.03	.26	-.00
60.0	0.00	.01	0.00	.00	-200.00	-70.37	.01	.00
65.0	.32	.01	-.02	-.00	-44.55	-78.45	-.31	.02
70.0	.64	-.02	-.06	-.00	-38.33	-64.53	-.66	.05
75.0	.99	.02	-.11	-.00	-34.05	-71.54	-.98	.11
80.0	1.13	-.02	-.19	.00	-30.66	-66.46	-1.15	.19
85.0	1.07	.01	-.29	.00	-28.46	-64.16	-1.07	.29
90.0	.70	.03	-.38	-.00	-27.65	-64.43	-.67	.38
95.0	-.00	-.00	-.44	-.00	-27.87	-67.06	-.00	.44
100.0	-.84	-.04	-.44	.00	-27.91	-65.61	.80	.44
105.0	-1.52	.00	-.38	.01	-29.58	-64.83	1.52	.39
110.0	-1.85	.04	-.29	-.01	-32.60	-65.28	1.89	.28
TOTAL	.87	.02	.20	.00	-32.04	-66.82		

NET REDUCTION OF MISMATCH ERRORS 34.78DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00024	-.00000
2	0.00000	0.00000	-.00098	.00000
3	0.00000	0.00000	.00331	-.00000
4	0.00000	0.00000	-.00517	.00000
5	0.00000	0.00000	.00446	-.00000
6	0.00000	0.00000	.00730	.00000
7	0.00000	0.00000	.00167	-.00000
8	1.00000	0.00000	1.00705	.00000
9	0.00000	0.00000	.00278	-.00000
10	0.00000	0.00000	-.00539	.00000
11	0.00000	0.00000	.00148	-.00000
12	0.00000	0.00000	-.00219	.00000
13	0.00000	0.00000	.00076	-.00000
14	0.00000	0.00000	-.00049	.00000
15	0.00000	0.00000	.00035	-.00000
16	0.00000	0.00000	-.00046	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 10 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.60	-.01	-.13	-.00	-34.87	-70.37	.59	.13
20.0	-.65	.00	-.13	.00	-34.62	-75.69	.66	.13
25.0	-.67	.02	-.11	.01	-35.39	-63.03	.69	.12
30.0	-.71	-.01	-.11	-.01	-36.02	-63.34	.70	.10
35.0	-.71	-.03	-.09	-.00	-36.34	-65.89	.68	.09
40.0	-.62	.01	-.07	.00	-37.42	-70.16	.64	.07
45.0	-.50	.05	-.05	-.00	-39.57	-61.64	.54	.05
50.0	-.49	-.08	-.03	.01	-41.44	-56.82	.41	.03
55.0	-.24	.00	-.02	-.01	-46.85	-64.50	.24	.02
60.0	0.00	.03	0.00	.00	-200.00	-62.63	.03	.00
65.0	.23	.03	-.00	-.00	-47.72	-65.07	-.21	.00
70.0	.46	-.02	-.01	-.00	-42.21	-65.30	-.48	.01
75.0	.68	-.06	-.03	.01	-38.85	-58.79	-.74	.03
80.0	.94	.01	-.06	.00	-34.86	-72.89	-.92	.06
85.0	1.00	.02	-.10	.00	-33.55	-67.03	-.98	.10
90.0	.94	.05	-.15	-.01	-33.31	-58.05	-.89	.14
95.0	.61	-.06	-.16	-.00	-35.19	-61.03	-.68	.16
100.0	.42	-.00	-.16	.00	-36.51	-71.01	-.43	.16
105.0	.15	-.06	-.11	.01	-41.17	-61.12	-.21	.12
110.0	.19	.13	-.06	-.01	-48.48	-58.01	-.06	.05
TOTAL	.60	.05	.09	.00	-36.43	-61.59		

NET REDUCTION OF MISMATCH ERRORS   25.15DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00011	-.00000
2	0.00000	0.00000	-.00221	.00000
3	0.00000	0.00000	.00539	-.00000
4	0.00000	0.00000	-.00980	.00000
5	0.00000	0.00000	.00922	-.00000
6	0.00000	0.00000	.00251	.00000
7	0.00000	0.00000	-.00477	-.00000
8	1.00000	0.00000	1.00063	.00000
9	0.00000	0.00000	-.00782	-.00000
10	0.00000	0.00000	-.00212	.00000
11	0.00000	0.00000	-.00145	-.00000
12	0.00000	0.00000	-.00025	.00000
13	0.00000	0.00000	-.00016	-.00000
14	0.00000	0.00000	-.00023	.00000
15	0.00000	0.00000	.00015	-.00000
16	0.00000	0.00000	-.00003	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 11 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.44	.02	.00	.00	-42.51	-70.09	.46	-.00
20.0	-.61	-.02	-.00	-.00	-39.37	-68.31	.59	.00
25.0	-.68	-.01	-.01	-.00	-36.54	-73.96	.67	.01
30.0	-.67	.03	-.01	.00	-37.43	-66.51	.70	.01
35.0	-.67	.01	-.00	.00	-39.06	-79.71	.67	.00
40.0	-.61	-.01	-.00	-.00	-39.43	-73.49	.60	-.00
45.0	-.51	-.01	.00	-.00	-41.10	-74.17	.50	-.00
50.0	-.37	-.01	.00	.00	-44.44	-79.70	.37	-.00
55.0	-.19	.02	.00	.00	-50.08	-70.94	.21	-.00
60.0	0.00	.00	0.00	.00	-200.00	-73.07	.00	.00
65.0	.26	.01	-.02	-.00	-46.22	-70.35	-.25	.01
70.0	.50	-.02	-.05	-.00	-42.52	-67.62	-.52	.04
75.0	.77	.02	-.09	.01	-36.24	-70.62	-.75	.09
80.0	.83	-.01	-.14	.00	-33.06	-68.41	-.85	.15
85.0	.74	-.00	-.22	.00	-31.06	-73.52	-.74	.22
90.0	.44	.03	-.28	-.00	-30.28	-64.09	-.41	.28
95.0	-.11	.00	-.32	-.00	-30.57	-70.30	.11	.32
100.0	-.72	-.04	-.31	.00	-30.70	-64.65	.68	.31
105.0	-1.15	-.00	-.26	.01	-32.65	-65.48	1.14	.26
110.0	-1.30	.05	-.18	-.01	-36.13	-64.36	1.35	.17
TOTAL	.66	.02	.15	.00	-34.64	-67.93		

NET REDUCTION OF MISMATCH ERRORS= 33.29DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00016	-.00000
2	0.00000	0.00000	-.00194	.00000
3	0.00000	0.00000	.00440	-.00000
4	0.00000	0.00000	-.00848	.00000
5	0.00000	0.00000	.00500	-.00000
6	0.00000	0.00000	.00226	.00000
7	0.00000	0.00000	-.00545	-.00000
8	1.00000	0.00000	1.00708	.00000
9	0.00000	0.00000	-.00602	-.00000
10	0.00000	0.00000	-.00330	.00000
11	0.00000	0.00000	-.00011	-.00000
12	0.00000	0.00000	-.00065	.00000
13	0.00000	0.00000	.00034	-.00000
14	0.00000	0.00000	-.00002	.00000
15	0.00000	0.00000	.00024	-.00000
16	0.00000	0.00000	.00004	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 12 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.18	.03	.03	.00	-47.15	-64.96	.21	-.03
20.0	-.36	-.03	.01	-.00	-43.60	-65.20	.33	-.01
25.0	-.45	-.01	.00	.00	-42.11	-68.65	.44	-.00
30.0	-.51	-.00	-.01	-.00	-41.68	-68.99	.51	.01
35.0	-.53	.00	-.01	.00	-41.05	-74.85	.53	.01
40.0	-.47	.03	-.01	.00	-41.51	-65.20	.50	.01
45.0	-.40	.03	-.01	-.00	-42.00	-63.94	.44	.01
50.0	-.46	-.12	-.01	.00	-42.53	-54.40	.35	.01
55.0	-.22	.01	-.01	-.00	-48.74	-66.53	.22	.01
60.0	0.00	.05	0.00	.01	-200.00	-59.53	.05	.01
65.0	.21	.03	-.01	-.00	-47.96	-65.25	-.18	.01
70.0	.42	-.01	-.04	-.00	-41.82	-66.52	-.43	.03
75.0	.59	-.08	-.07	.00	-38.48	-57.64	-.67	.07
80.0	.82	.01	-.12	-.00	-33.86	-75.38	-.81	.12
85.0	.84	.04	-.16	.00	-31.92	-61.61	-.80	.16
90.0	.63	.04	-.24	-.00	-31.19	-61.99	-.59	.24
95.0	.16	-.07	-.27	-.00	-31.88	-60.32	-.22	.27
100.0	-.23	-.01	-.27	.00	-32.39	-76.72	.22	.27
105.0	-.63	-.02	-.22	.00	-34.75	-70.20	.61	.23
110.0	-.76	.07	-.15	-.00	-39.08	-63.96	.83	.15
TOTAL	.50	.04	.15	.00	-38.11	-61.64		

NET REDUCTION OF MISMATCH ERROR= 25.55DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00018	.00000
2	0.00000	0.00000	-.00091	.00000
3	0.00000	0.00000	.00366	.00000
4	0.00000	0.00000	-.00746	.00000
5	0.00000	0.00000	.00976	.00000
6	0.00000	0.00000	-.00321	.00000
7	0.00000	0.00000	.00234	.00000
8	1.00000	0.00000	1.00138	.00000
9	0.00000	0.00000	-.00209	-.00000
10	0.00000	0.00000	-.00351	.00000
11	0.00000	0.00000	-.00044	-.00000
12	0.00000	0.00000	-.00140	.00000
13	0.00000	0.00000	.00000	-.00000
14	0.00000	0.00000	-.00061	.00000
15	0.00000	0.00000	.00001	-.00000
16	0.00000	0.00000	-.00037	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 13 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.40	-.00	-.00	.00	-41.62	-72.22	.49	-.00
20.0	-.54	-.00	-.00	.00	-40.36	-69.40	.54	.01
25.0	-.54	-.00	-.00	.00	-40.51	-78.11	.54	.01
30.0	-.51	.01	-.00	-.00	-41.77	-72.81	.53	.00
35.0	-.49	.00	-.00	-.00	-41.62	-70.28	.49	.00
40.0	-.43	-.01	-.00	-.00	-42.37	-75.60	.43	-.00
45.0	-.35	-.01	.00	.00	-44.30	-68.45	.34	.00
50.0	-.25	-.01	.00	.00	-47.81	-76.10	.25	-.00
55.0	-.13	.01	.00	-.00	-200.00	-79.83	.13	-.00
60.0	0.00	.01	0.00	-.00	-49.49	-65.50	-.14	.01
65.0	-.16	.02	-.01	-.00	-44.38	-72.44	-.28	.03
70.0	-.20	.01	-.03	-.00	-41.42	-57.45	-.37	.07
75.0	-.29	-.08	-.07	.00	-37.19	-64.53	-.36	.11
80.0	-.38	.02	-.10	.00	-35.22	-63.54	-.19	.15
85.0	-.27	.04	-.15	.00	-34.60	-62.80	.14	.17
90.0	-.12	.01	-.18	-.01	-35.11	-66.37	.55	.16
95.0	-.57	-.02	-.17	-.00	-35.02	-63.18	.93	.13
100.0	-.96	-.04	-.12	.01	-34.95	-64.53	1.17	.05
105.0	-1.19	-.02	-.05	.01	-40.06	-59.59	1.18	-.04
110.0	-1.09	.10	.03	-.01	-38.62	-64.38		
TOTAL	.55	.03	.07	.00				

NET REDUCTION OF MISMATCH ERROR= 25.77DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00054	.00000
2	0.00000	0.00000	-.00456	-.00000
3	0.00000	0.00000	.00900	.00000
4	0.00000	0.00000	-.01711	-.00000
5	0.00000	0.0000C	.01587	.00000
6	0.00000	0.00000	.00333	-.00000
7	0.00000	0.00000	-.00474	.00000
8	1.00000	0.00000	1.01704	-.00000
9	0.00000	0.00000	-.01110	.00000
10	0.00000	0.00000	.00059	-.00000
11	0.00000	0.00000	-.00137	.00000
12	0.00000	0.00000	.00141	-.00000
13	0.00000	0.00000	-.00001	.00000
14	0.00000	0.00000	.00103	-.00000
15	0.00000	0.00000	.00020	.00000
16	0.00000	0.00000	.00045	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 14 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.28	.05	-.08	.00	-40.11	-61.08	.33	.08
20.0	-.68	-.05	-.08	-.00	-36.65	-60.01	.61	.07
25.0	-.87	-.01	-.07	.00	-35.49	-68.58	.86	.07
30.0	-1.01	.01	-.06	-.00	-35.25	-71.59	1.02	.06
35.0	-1.04	.01	-.04	.00	-34.97	-67.68	1.05	.05
40.0	-.98	.03	-.03	.00	-35.55	-60.36	.96	.03
45.0	-.78	.03	-.02	.00	-37.33	-63.07	.80	.01
50.0	-.70	-.10	.00	.00	-38.97	-55.71	.60	.00
55.0	-.36	-.01	-.00	-.00	-44.59	-68.50	.35	-.00
60.0	0.00	.05	0.00	.01	-200.00	-58.82	.05	.01
65.0	.36	.04	-.03	-.00	-42.92	-62.35	-.31	.03
70.0	.68	-.03	-.08	-.00	-37.10	-63.48	-.70	.07
75.0	.96	-.07	-.14	.00	-33.23	-59.07	-1.03	.14
80.0	1.18	.01	-.24	.00	-29.17	-77.31	-1.17	.24
85.0	1.04	.02	-.35	.01	-27.06	-61.55	-1.01	.36
90.0	.55	.06	-.47	-.01	-26.08	-59.14	-.50	.46
95.0	-.41	-.07	-.53	-.00	-26.33	-59.66	.34	.52
100.0	-1.33	-.01	-.52	.00	-26.32	-80.32	1.32	.52
105.0	-2.2	-.02	-.43	.01	-27.84	-64.97	2.19	.43
110.0	-2.56	.07	-.30	-.01	-30.94	-63.03	2.63	.29
TOTAL	1.08	.05	.24	.00	-30.48	-61.16		

NET REDUCTION OF MISMATCH ERROR= 30.69DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00032	-.00000
2	0.00000	0.00000	-.00413	-.00000
3	0.00000	0.00000	.00917	-.00000
4	0.00000	0.00000	-.01702	-.00000
5	0.00000	0.00000	.01663	-.00000
6	0.00000	0.00000	.00605	-.00000
7	0.00000	0.00000	-.00297	-.00000
8	1.00000	0.00000	1.01885	-.00000
9	0.00000	0.00000	-.00815	-.00000
10	0.00000	0.00000	-.00059	-.00000
11	0.00000	0.00000	-.00140	-.00000
12	0.00000	0.00000	.00077	-.00000
13	0.00000	0.00000	-.00016	-.00000
14	0.00000	0.00000	.00045	-.00000
15	0.00000	0.00000	.00017	-.00000
16	0.00000	0.00000	.00022	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 15 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.53	.04	-.14	.00	-34.80	-64.55	.57	.14
20.0	-.86	-.04	-.14	-.00	-33.15	-65.37	.83	.14
25.0	-1.06	-.02	-.12	-.00	-32.80	-70.13	1.04	.12
30.0	-1.13	.02	-.10	.00	-33.69	-66.61	1.16	.10
35.0	-1.13	.03	-.08	.00	-33.74	-67.16	1.16	.08
40.0	-1.05	-.00	-.05	-.00	-34.23	-72.98	1.05	.05
45.0	-.89	-.02	-.03	-.00	-36.05	-67.76	.87	.03
50.0	-.67	-.02	-.01	-.00	-39.37	-68.94	.64	.01
55.0	-.35	-.02	-.00	.00	-44.94	-69.43	.36	.00
60.0	0.00	.02	0.00	.00	-200.00	-66.28	.02	.00
65.0	.41	.01	-.02	-.00	-42.33	-71.33	-.41	.02
70.0	.83	-.02	-.06	-.00	-36.27	-65.87	-.86	.06
75.0	1.25	.01	-.13	-.00	-32.16	-76.49	-1.24	.13
80.0	1.30	-.02	-.23	.00	-29.92	-64.42	-1.41	.23
85.0	1.26	.00	-.35	.00	-26.90	-67.47	-1.26	.35
90.0	.77	.05	-.46	-.01	-26.10	-60.32	-.72	.45
95.0	-.15	-.01	-.52	-.01	-26.52	-65.79	.14	.51
100.0	-1.18	-.05	-.50	.00	-26.60	-62.16	1.13	.50
105.0	-2.01	-.02	-.41	.01	-26.36	-62.70	1.99	.42
110.0	-2.34	.08	-.26	-.01	-31.59	-60.84	2.42	.27
TOTAL	1.11	.03	.24	.00	-30.25	-64.53		

NET REDUCTION OF MISMATCH ERRORS 34.2800.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00082	.00000
2	0.00000	0.00000	-.00360	-.00000
3	0.00000	0.00000	.00794	.00000
4	0.00000	0.00000	-.01345	-.00000
5	0.00000	0.00000	.01143	.00000
6	0.00000	0.00000	.00709	-.00000
7	0.00000	0.00000	-.00335	.00000
8	1.00000	0.00000	1.01684	-.00000
9	0.00000	0.00000	-.00597	-.00000
10	0.00000	0.00000	-.00111	-.00000
11	0.00000	0.00000	-.00057	-.00000
12	0.00000	0.00000	.00022	-.00000
13	0.00000	0.00000	.00008	-.00000
14	0.00000	0.00000	.00032	-.00000
15	0.00000	0.00000	.00016	-.00000
16	0.00000	0.00000	.00014	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 16 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.45	.03	-.13	.00	-35.85	-65.43	.48	.13
20.0	-.69	-.03	-.12	-.00	-34.50	-64.81	.67	.12
25.0	-.83	-.01	-.11	.00	-34.46	-67.70	.82	.11
30.0	-.91	.00	-.10	-.00	-34.91	-68.50	.92	.10
35.0	-.93	.00	-.08	.00	-35.00	-70.78	.94	.08
40.0	-.86	.02	-.06	.00	-35.58	-69.94	.88	.06
45.0	-.72	.04	-.04	-.00	-37.51	-63.47	.75	.04
50.0	-.67	-.10	-.02	.00	-39.28	-56.24	.57	.02
55.0	-.34	-.01	-.01	-.00	-44.84	-67.07	.34	.01
60.0	0.00	.04	0.00	.01	-200.00	-59.70	.04	.01
65.0	.33	.03	-.02	-.00	-44.17	-65.54	-.31	.02
70.0	.68	-.01	-.05	-.00	-58.11	-65.49	-.69	.04
75.0	.97	-.07	-.10	.00	-34.48	-58.99	-1.04	.10
80.0	1.26	.00	-.18	.00	-30.42	-97.28	-1.26	.18
85.0	1.26	.03	-.27	.00	-28.38	-61.82	-1.23	.28
90.0	.93	.05	-.37	-.00	-27.58	-60.92	-.88	.37
95.0	.18	-.06	-.43	-.00	-28.03	-60.62	-.25	.43
100.0	-.56	-.01	-.43	.00	-28.23	-75.07	.55	.44
105.0	-1.30	-.01	-.37	.01	-30.09	-65.90	1.29	.37
110.0	-1.64	.07	-.26	-.01	-33.53	-63.40	1.71	.26
TOTAL	.87	.04	.21	.00	-31.77	-62.28		

NET REDUCTION OF MISMATCH ERROR=   30.51DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00057	.00000
2	0.00000	0.00000	-.00156	.00000
3	0.00000	0.00000	.00676	.00000
4	0.00000	0.00000	-.00965	.00000
5	0.00000	0.00000	.01254	.00000
6	0.00000	0.00000	.00205	.00000
7	0.00000	0.00000	.00069	.00000
8	1.00000	0.00000	1.00718	.00000
9	0.00000	0.00000	-.00452	.00000
10	0.00000	0.00000	-.00471	.00000
11	0.00000	0.00000	-.00166	.00000
12	0.00000	0.00000	-.00223	.00000
13	0.00000	0.00000	-.00071	.00000
14	0.00000	0.00000	-.00136	.00000
15	0.00000	0.00000	-.00025	.00000
16	0.00000	0.00000	-.00064	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 17 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.16	-.05	-.06	-.00	-33.74	-60.21	1.11	.05
20.0	-1.05	.04	-.05	.00	-34.16	-61.39	1.10	.06
25.0	-.96	.03	-.05	.00	-35.17	-64.84	.99	.05
30.0	-.88	-.01	-.04	-.00	-36.72	-70.95	.87	.04
35.0	-.81	-.03	-.03	-.00	-37.17	-64.11	.78	.03
40.0	-.70	-.01	-.02	-.00	-37.98	-72.84	.69	.02
45.0	-.58	.01	-.01	.00	-39.88	-68.86	.59	.02
50.0	-.42	.01	-.01	.00	-43.35	-70.04	.43	.01
55.0	-.22	.02	-.00	.00	-49.00	-70.81	.23	.00
60.0	0.00	-.00	0.00	-.00	-200.00	-81.17	-.00	-.00
65.0	.26	-.01	-.01	-.00	-46.37	-65.19	-.27	.01
70.0	.52	-.02	-.04	-.00	-40.44	-68.48	-.54	.04
75.0	.79	.03	-.08	.00	-36.24	-65.33	-.76	.08
80.0	.83	-.02	-.14	.01	-33.38	-61.96	-.85	.14
85.0	.73	.01	-.21	.00	-31.41	-75.28	-.72	.21
90.0	.38	.03	-.27	-.01	-30.85	-59.98	-.35	.26
95.0	-.21	-.01	-.29	-.00	-31.45	-67.07	.20	.28
100.0	-.83	-.04	-.26	.01	-31.41	-61.85	.79	.26
105.0	-1.27	-.02	-.18	.01	-33.97	-61.25	1.25	.19
110.0	-1.34	.09	-.09	-.01	-37.77	-58.82	1.43	.07
TOTAL	.78	.03	.13	.01	-34.46	-63.20		

NET REDUCTION OF MISMATCH ERROR= 28.75DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00037	.00000
2	0.00000	0.00000	-.00013	-.00000
3	0.00000	0.00000	.00371	-.00000
4	0.00000	0.00000	-.00496	.00000
5	0.00000	0.00000	.01007	.00000
6	0.00000	0.00000	-.00171	.00000
7	0.00000	0.00000	-.00010	.00000
8	1.00000	0.00000	1.00113	-.00000
9	0.00000	0.00000	-.00705	.00000
10	0.00000	0.00000	-.00479	-.00000
11	0.00000	0.00000	-.00171	.00000
12	0.00000	0.00000	-.00238	-.00000
13	0.00000	0.00000	-.00068	.00000
14	0.00000	0.00000	-.00127	.00000
15	0.00000	0.00000	-.00021	-.00000
16	0.00000	0.00000	-.00060	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 18 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.11	-.06	.05	-.00	-34.07	-59.11	1.05	-.06
20.0	-.96	.05	.05	.00	-34.86	-60.70	1.00	-.05
25.0	-.81	.05	.05	.00	-36.33	-59.88	.86	-.05
30.0	-.74	-.04	.04	-.01	-38.11	-60.82	.71	-.04
35.0	-.64	-.05	.04	-.00	-38.84	-61.19	.59	-.04
40.0	-.49	.01	.03	.00	-40.53	-76.69	.50	-.03
45.0	-.35	.05	.02	.00	-43.46	-60.96	.40	-.02
50.0	-.34	-.06	.02	.01	-44.39	-59.03	.29	-.02
55.0	-.13	.02	.01	-.00	-52.75	-67.00	.15	-.01
60.0	0.00	.01	0.00	.00	-200.00	-74.09	.01	.00
65.0	.13	.01	-.03	-.01	-48.55	-64.63	-.12	.02
70.0	.22	-.01	-.05	-.00	-43.28	-69.54	-.23	.05
75.0	.25	-.04	-.08	.01	-40.41	-59.68	-.28	.09
80.0	.26	.01	-.13	.00	-36.38	-70.74	-.24	.13
85.0	.11	.03	-.16	.00	-34.72	-65.90	-.08	.16
95.0	-.61	-.09	-.18	.00	-34.67	-58.29	.52	.18
100.0	-.78	.04	-.15	.00	-35.46	-64.35	.82	.15
105.0	-1.02	-.03	-.09	.01	-37.33	-64.31	.99	.10
110.0	-.93	.06	-.02	-.01	-41.51	-62.58	.98	.01
TOTAL	.61	.04	.09	.00	-37.00	-61.31		

NET REDUCTION OF MISMATCH ERROR= 24.30DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00048	.00000
2	0.00000	0.00000	-.00054	-.00000
3	0.00000	0.00000	.00369	.00000
4	0.00000	0.00000	-.00869	-.00000
5	0.00000	0.00000	.01150	.00000
6	0.00000	0.00000	-.00295	-.00000
7	0.00000	0.00000	.00247	.00000
8	1.00000	0.00000	1.00243	-.00000
9	0.00000	0.00000	-.00286	.00000
10	0.00000	0.00000	-.00475	-.00000
11	0.00000	0.00000	.00029	.00000
12	0.00000	0.00000	-.00165	-.00000
13	0.00000	0.00000	-.00046	.00000
14	0.00000	0.00000	-.00069	-.00000
15	0.00000	0.00000	-.00020	.00000
16	0.00000	0.00000	-.00045	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 19 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.61	-.05	-.02	-.00	-39.52	-65.73	.59	.01
20.0	-.62	.02	-.02	.00	-39.00	-67.88	.64	.02
25.0	-.63	.00	-.02	.00	-39.07	-68.54	.64	.02
30.0	-.59	.02	-.01	-.00	-40.49	-68.63	.62	.01
35.0	-.60	-.02	-.01	-.01	-39.97	-62.71	.58	.00
40.0	-.53	-.00	.00	-.00	-40.57	-74.93	.53	-.00
45.0	-.45	.00	.00	.00	-42.17	-70.93	.45	-.00
50.0	-.37	-.03	.01	.00	-44.35	-63.30	.34	-.00
55.0	-.16	.03	.01	.00	-51.05	-64.21	.20	-.00
60.0	0.00	.02	0.00	-.00	-200.00	-68.94	.02	-.00
65.0	.19	.00	-.02	-.01	-47.46	-6)	-.19	.02
70.0	.36	-.03	-.05	-.00	-41.74	-6.	-.39	.05
75.0	.50	-.05	-.09	.00	-37.80	-63.09	-.53	.10
80.0	.53	.01	-.14	.01	-34.45	-59.91	-.52	.15
85.0	.33	.01	-.20	-.00	-32.63	-70.36	-.32	.19
90.0	-.01	.05	-.22	-.01	-32.61	-57.84	.06	.21
95.0	-.53	.00	-.20	-.00	-34.06	-73.69	.53	.20
100.0	-1.07	-.11	-.14	.00	-34.44	-55.86	.96	.14
105.0	-1.21	.02	-.04	.01	-36.91	-58.86	1.22	.05
110.0	-1.17	.12	.04	-.02	-39.71	-56.68	1.24	-.06
TOTAL	.61	.04	.09	.01	-36.87	-61.32		

NET REDUCTION OF MISMATCH ERROR= 24.45DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00245	.00000
2	0.00000	0.00000	-.00262	.00000
3	0.00000	0.00000	.01525	.00000
4	0.00000	0.00000	-.01731	.00000
5	0.00000	0.00000	.03704	-.00000
6	0.00000	0.00000	-.00568	.00000
7	0.00000	0.00000	-.01972	.00000
8	1.00000	0.00000	1.00811	.00000
9	0.00000	0.00000	-.04674	-.00000
10	0.00000	0.00000	-.01071	.00000
11	0.00000	0.00000	-.01012	.00000
12	0.00000	0.00000	-.00410	.00000
13	0.00000	0.00000	-.00555	-.00000
14	0.00000	0.00000	-.00145	.00000
15	0.00000	0.00000	-.00220	-.00000
16	0.00000	0.00000	-.00161	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 20 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-4.06	-.18	.46	-.01	-21.07	-50.24	3.88	-.47
20.0	-3.57	.16	.45	.01	-21.51	-50.44	3.73	-.44
25.0	-3.11	.07	.43	.01	-22.55	-56.32	3.18	-.42
30.0	-2.62	-.04	.39	-.01	-24.55	-58.75	2.57	-.39
35.0	-2.20	-.12	.35	-.01	-25.35	-53.25	2.08	-.35
40.0	-1.60	-.01	.30	.00	-26.68	-75.80	1.68	-.30
45.0	-1.23	.05	.23	.00	-29.22	-60.04	1.29	-.23
50.0	-.78	.06	.17	.01	-33.20	-57.78	.84	-.16
55.0	-.38	-.01	.09	-.00	-39.04	-73.14	.37	-.09
60.0	0.00	-.05	0.00	.00	-200.00	-61.19	-.05	.00
65.0	.39	.01	-.12	-.01	-36.36	-59.40	-.38	.11
70.0	.61	.01	-.25	-.00	-30.87	-67.30	-.60	.25
75.0	.67	-.04	-.39	.01	-27.40	-58.14	-.71	.40
80.0	.67	.05	-.55	.01	-23.94	-58.60	-.62	.56
85.0	.23	.01	-.70	.00	-22.08	-73.22	-.22	.70
90.0	-.59	.01	-.82	-.01	-21.54	-56.00	.60	.80
95.0	-1.88	-.08	-.85	-.01	-21.94	-57.41	1.79	.84
100.0	-3.12	.01	-.79	.01	-22.02	-61.68	3.12	.80
105.0	-4.15	.07	-.65	.02	-23.50	-54.50	4.21	.67
110.0	-4.66	-.03	-.50	-.03	-26.11	-55.97	4.65	.47
TOTAL	2.34	.07	.46	.01	-23.84	-55.72		

NET REDUCTION OF MISMATCH ERROR: 31.86DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.06656	-.00000
2	0.00000	0.00000	-.44161	.00000
3	0.00000	0.00000	-.30999	-.00000
4	0.00000	0.00000	-.53044	.00000
5	0.00000	0.00000	-.24234	.00000
6	0.00000	0.00000	-.63814	.00000
7	0.00000	0.00000	.08258	.00000
8	1.00000	0.00000	-.61676	.00000
9	0.00000	0.00000	-.21480	.00000
10	0.00000	0.00000	-.64348	.00000
11	0.00000	0.00000	-.14090	.00000
12	0.00000	0.00000	-.58114	.00000
13	0.00000	0.00000	-.03589	.00000
14	0.00000	0.00000	-.56564	.00000
15	0.00000	0.00000	-.12638	.00000
16	0.00000	0.00000	-.21027	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 21 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	217.45	35.79	-.35	-1.29	5.11	-4.89	-181.67	-.94
20.0	66.77	36.91	-.86	-5.67	.56	-3.45	-29.85	-4.81
25.0	38.46	19.73	-.57	.01	-3.93	-9.36	-18.73	.58
30.0	-20.62	-23.44	-.09	-2.16	-9.80	-8.35	-2.83	-2.0A
35.0	-69.11	-9.83	-.36	-6.13	.52	-6.08	59.28	-5.77
40.0	-87.96	-347.70	-.83	-2.93	2.51	-9.36	-259.74	-2.10
45.0	-237.62	-129.65	-.49	-2.88	4.46	3.80	107.97	-2.19
50.0	244.41	-12.68	.33	-7.30	4.00	-5.34	-257.09	-7.63
55.0	-65.37	-44.95	.03	-16.80	.11	-1.56	15.42	-16.83
60.0	0.00	-18.81	0.00	-9.63	-200.00	-3.15	-18.81	-9.63
65.0	-265.36	99.36	-.62	-9.76	3.09	.87	364.72	-9.13
70.0	215.25	-91.28	.08	-8.50	5.17	.16	-306.53	-8.50
75.0	-40.79	-306.69	-.04	-5.42	-3.73	-2.44	-265.91	-5.8A
80.0	-68.35	51.36	-.59	-4.46	.84	-2.03	119.71	-5.87
85.0	194.04	-32.89	-.63	-4.10	5.76	-4.55	-226.94	-3.48
90.0	-184.85	305.76	.20	-5.56	5.46	-2.45	490.61	-5.76
95.0	-27.76	63.25	.92	-9.95	-7.49	-2.67	91.00	-10.87
100.0	-68.34	318.67	1.89	-8.79	-.03	-4.47	387.01	-10.68
105.0	-254.65	64.21	3.48	-13.42	2.50	-4.19	318.86	-16.90
110.0	-196.00	10.89	5.23	2.39	3.14	-14.11	206.89	-2.84
TOTAL	156.56	152.26	1.79	3.04	2.91	-1.91		

NET REDUCTION OF MISMATCH ERROR= 4.82DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00082	-.00000
2	0.00000	0.00000	-.00207	.00000
3	0.00000	0.00000	.00701	-.00000
4	0.00000	0.00000	-.01206	.00000
5	0.00000	0.00000	.01390	-.00000
6	0.00000	0.00000	.00084	.00000
7	0.00000	0.00000	-.00636	-.00000
8	1.00000	0.00000	1.01043	.00000
9	0.00000	0.00000	-.01385	-.00000
10	0.00000	0.00000	-.00202	.00000
11	0.00000	0.00000	-.00287	-.00000
12	0.00000	0.00000	-.00032	.00000
13	0.00000	0.00000	-.00094	-.00000
14	0.00000	0.00000	-.00004	.00000
15	0.00000	0.00000	-.00024	-.00000
16	0.00000	0.00000	-.00005	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 22 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.86	-.00	.05	-.00	-36.12	-83.83	.85	-.05
20.0	-.95	-.00	.04	-.00	-35.10	-80.38	.94	-.04
25.0	-.95	.01	.04	.00	-35.33	-65.77	.96	-.04
30.0	-.92	.00	.03	-.01	-36.54	-65.24	.92	-.03
35.0	-.89	-.03	.03	.00	-36.39	-66.60	.86	-.03
40.0	-.75	.01	.03	.00	-37.32	-72.29	.77	-.03
45.0	-.60	.04	.02	-.00	-39.45	-62.29	.64	-.02
50.0	-.55	-.08	.02	.00	-40.82	-58.01	.47	-.02
55.0	-.26	.00	.01	-.00	-47.20	-66.88	.27	-.01
60.0	0.00	.03	0.00	.00	-200.00	-62.69	.03	.00
65.0	.26	.02	-.03	-.00	-44.49	-65.74	-.23	.03
70.0	.48	-.02	-.08	-.00	-38.78	-65.61	-.49	.07
75.0	.65	-.05	-.13	.00	-35.03	-60.65	-.70	.14
80.0	.80	.02	-.22	.00	-30.92	-68.31	-.77	.22
85.0	.64	.01	-.30	.00	-28.85	-64.97	-.63	.30
90.0	.25	.04	-.39	-.01	-27.83	-60.29	-.21	.38
95.0	-.52	-.07	-.43	-.00	-28.04	-59.44	.45	.42
100.0	-1.10	.12	-.41	.00	-28.05	-69.70	1.20	.42
105.0	-1.86	-.02	-.35	.01	-29.50	-66.10	1.85	.35
110.0	-2.09	.05	-.25	-.01	-32.65	-64.65	2.14	.24
TOTAL	.92	.03	.20	.00	-32.02	-63.09		

NET REDUCTION OF MISMATCH ERRORS 31.07DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00020	-.00000
2	0.00000	0.00000	-.00176	.00000
3	0.00000	0.00000	.00475	-.00000
4	0.00000	0.00000	-.00946	.00000
5	0.00000	0.00000	.00836	-.00000
6	0.00000	0.00000	.00637	.00000
7	0.00000	0.00000	.00251	-.00000
8	1.00000	0.00000	1.01088	.00000
9	0.00000	0.00000	.00234	-.00000
10	0.00000	0.00000	-.00403	.00000
11	0.00000	0.00000	.00106	-.00000
12	0.00000	0.00000	-.00136	.00000
13	0.00000	0.00000	.00065	-.00000
14	0.00000	0.00000	-.00068	.00000
15	0.00000	0.00000	.00036	-.00000
16	0.00000	0.00000	-.00026	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 23 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEG.	8)	(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.47	.01	-.18	-.00	-33.53	-74.77	.48	.18
20.0	-.64	-.02	-.17	.00	-32.92	-70.78	.62	.17
25.0	-.74	-.00	-.15	.00	-33.35	-78.08	.74	.15
30.0	-.78	.02	-.13	.00	-34.70	-71.09	.80	.13
35.0	-.80	.00	-.11	-.00	-35.02	-75.97	.80	.11
40.0	-.74	.00	-.08	-.00	-35.83	-74.52	.74	.08
45.0	-.63	-.01	-.06	.00	-37.86	-72.63	.62	.06
50.0	-.48	-.01	-.04	.00	-41.32	-72.62	.47	.04
55.0	-.26	.01	-.02	.00	-46.91	-72.87	.27	.02
60.0	0.00	.01	0.00	.00	-200.00	-69.87	.01	.00
65.0	.31	.00	-.00	-.00	-45.18	-67.72	-.31	-.00
70.0	.64	-.02	-.02	-.00	-39.36	-67.54	-.66	.02
75.0	.90	.02	-.05	.00	-35.35	-71.58	-.97	.05
80.0	1.11	-.03	-.10	.01	-32.84	-61.57	-1.14	.11
85.0	1.10	.01	-.17	.00	-31.27	-75.34	-1.09	.17
90.0	.85	.05	-.23	-.01	-31.20	-60.27	-.81	.22
95.0	.37	.00	-.25	-.00	-32.50	-68.21	-.37	.25
100.0	-.17	-.06	-.22	.00	-33.98	-60.88	.11	.23
105.0	-.54	-.05	-.16	.01	-37.43	-62.47	.50	.16
110.0	-.56	.13	-.07	-.01	-43.74	-58.00	.69	.06
TOTAL	.67	.04	.13	.00	-34.38	-64.74		

NET REDUCTION OF MISMATCH ERROR 30.37DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00133	-.00000
2	0.00000	0.00000	-.00520	.00000
3	0.00000	0.00000	.01223	-.00000
4	0.00000	0.00000	-.01971	-.00000
5	0.00000	0.00000	.01851	.00000
6	0.00000	0.00000	.00757	-.00000
7	0.00000	0.00000	-.00641	.00000
8	1.00000	0.00000	1.02251	-.00000
9	0.00000	0.00000	-.01308	.00000
10	0.00000	0.00000	-.00076	-.00000
11	0.00000	0.00000	-.00264	-.00000
12	0.00000	0.00000	.00043	.00000
13	0.00000	0.00000	-.00078	-.00000
14	0.00000	0.00000	.00033	.00000
15	0.00000	0.00000	-.00016	-.00000
16	0.00000	0.00000	.00008	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 24 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.89	.02	-.12	.00	-34.10	-70.19	.91	.12
20.0	-1.13	-.02	-.11	-.00	-32.48	-69.25	1.11	.11
25.0	-1.26	-.01	-.10	.00	-32.25	-68.15	1.25	.10
30.0	-1.31	.00	-.09	-.00	-32.83	-69.60	1.32	.09
35.0	-1.31	-.00	-.07	..0	-32.76	-77.26	1.31	.07
40.0	-1.19	.02	-.05	.00	-33.30	-69.71	1.21	.05
45.0	-1.00	.04	-.03	-.00	-35.09	-63.11	1.04	.03
50.0	-.88	-.10	-.01	.00	-37.04	-56.15	.78	.01
55.0	-.46	-.01	-.00	-.00	-42.43	-69.22	.45	.00
60.0	0.00	.05	0.00	.00	-200.00	-59.31	.05	.00
65.0	.43	.02	-.03	-.00	-41.79	-67.49	-.41	.02
70.0	.90	-.00	-.08	-.01	-35.35	-64.88	-.91	.07
75.0	1.27	-.08	-.15	.00	-31.56	-57.14	-1.35	.16
80.0	1.61	.01	-.27	.00	-27.50	-74.50	-1.60	.28
85.0	1.54	.05	-.41	.01	-25.34	-54.56	-1.50	.42
90.0	.99	.05	-.56	-.01	-24.48	-59.49	-.94	.55
95.0	-.13	-.09	-.64	-.00	-24.73	-57.45	.04	.64
100.0	-1.25	-.01	-.64	.00	-24.74	-72.08	1.23	.64
105.0	-2.32	.00	-.55	.01	-26.31	-61.46	2.32	.56
110.0	-2.86	.06	-.41	-.01	-29.31	-61.73	2.92	.40
TOTAL	1.31	.04	.30	.00	-28.67	-61.27		

NET REDUCTION OF MISMATCH ERROR= 32.59DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	-.00035	-.00000
2	0.00000	0.00000	-.00169	.00000
3	0.00000	0.00000	.00404	.00000
4	0.00000	0.00000	-.00883	-.00000
5	0.00000	0.00000	.00632	-.00000
6	0.00000	0.00000	.00493	.00000
7	0.00000	0.00000	.00101	-.00000
8	1.00000	0.00000	1.00843	.00000
9	0.00000	0.00000	.00223	-.00000
10	0.00000	0.00000	-.00421	.00000
11	0.00000	0.00000	.00146	-.00000
12	0.00000	0.00000	-.00117	.00000
13	0.00000	0.00000	.00090	-.00000
14	0.00000	0.00000	-.00055	.00000
15	0.00000	0.00000	.00047	-.00000
16	0.00000	0.00000	-.00018	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 25 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.23	.02	-.13	-.00	-36.76	-68.32	.24	.13
20.0	-.41	-.02	-.13	.00	-35.75	-68.65	.39	.13
25.0	-.56	-.03	-.12	.00	-35.66	-66.96	.53	.12
30.0	-.58	.04	-.10	.00	-36.96	-64.05	.62	.10
35.0	-.64	.01	-.09	-.00	-36.87	-73.58	.65	.09
40.0	-.61	-.00	-.07	-.00	-37.44	-75.09	.61	.07
45.0	-.53	-.02	-.05	.00	-39.27	-70.51	.52	.05
50.0	-.42	-.02	-.03	-.00	-42.45	-70.05	.40	.03
55.0	-.23	.01	-.01	.00	-48.08	-71.21	.24	.02
60.0	0.00	.02	0.00	.00	-200.00	-69.20	.02	.00
65.0	.29	.01	-.00	-.00	-46.01	-68.62	-.28	-.00
70.0	.58	-.03	-.01	-.00	-40.22	-65.83	-.61	.01
75.0	.92	.00	-.04	.00	-36.17	-79.39	-.91	.04
80.0	1.08	-.02	-.09	.00	-33.51	-63.95	-1.08	.09
85.0	1.05	.01	-.14	.00	-32.08	-73.62	-1.05	.15
90.0	.85	.05	-.20	-.01	-52.01	-60.13	-.81	.19
95.0	.42	.00	-.22	-.00	-33.46	-69.06	-.42	.22
100.0	-.06	-.06	-.20	.00	-35.19	-60.65	.00	.20
105.0	-.38	-.05	-.13	.01	-39.13	-62.56	.33	.14
110.0	-.37	.13	-.05	-.01	-46.83	-57.77	.50	.05
TOTAL	.58	.04	.11	.00	-35.82	-64.51		

NET REDUCTION OF MISMATCH ERROR = 28.49DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00020	.00000
2	0.00000	0.00000	-.00136	.00000
3	0.00000	0.00000	.00214	.00000
4	0.00000	0.00000	-.00927	.00000
5	0.00000	0.00000	.01075	.00000
6	0.00000	0.00000	.00169	.00000
7	0.00000	0.00000	.00594	.00000
8	1.00000	0.00000	1.00718	.00000
9	0.00000	0.00000	.00242	.00000
10	0.00000	0.00000	-.00375	.00000
11	0.00000	0.00000	.00072	.00000
12	0.00000	0.00000	-.00174	.00000
13	0.00000	0.00000	.00030	.00000
14	0.00000	0.00000	-.00091	.00000
15	0.00000	0.00000	.00012	.00000
16	0.00000	0.00000	-.00046	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 26 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ (HZ)	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.65	-.03	-.15	-.00	-33.89	-64.16	.62	.15
20.0	-.66	.01	-.14	.00	-34.02	-67.07	.68	.14
25.0	-.65	.04	-.12	.01	-34.98	-61.16	.69	.13
30.0	-.70	-.02	-.11	-.01	-35.76	-61.77	.69	.11
35.0	-.70	-.03	-.04	-.00	-36.36	-65.96	.67	.09
40.0	-.63	-.00	-.07	.00	-37.34	-62.18	.63	.07
45.0	-.51	.04	-.05	.00	-39.57	-63.05	.55	.05
50.0	-.47	-.05	-.02	.01	-41.93	-59.23	.42	.03
55.0	-.25	.00	-.02	-.00	-47.20	-69.36	.25	.01
60.0	0.00	.03	0.00	.00	-200.00	-64.78	.03	.00
65.0	.24	.03	-.01	-.00	-47.23	-62.76	-.22	.00
70.0	.43	-.04	-.03	-.00	-42.31	-62.50	-.47	.02
75.0	.64	-.04	-.05	.01	-38.58	-59.05	-.68	.06
80.0	.77	.01	-.10	.00	-34.80	-64.61	-.76	.11
85.0	.68	.03	-.15	.00	-33.41	-64.03	-.64	.16
90.0	.37	.05	-.24	-.01	-33.06	-57.58	-.32	.19
95.0	-.23	-.09	-.20	-.00	-34.37	-58.16	.14	.20
100.0	-.62	.00	-.16	.00	-35.47	-66.93	.62	.17
105.0	-1.01	-.03	-.08	.01	-37.60	-61.73	.98	.09
110.0	-1.00	.10	.02	-.01	-40.92	-58.65	1.10	-.03
TOTAL	.61	.04	.11	.01	-35.89	-61.34		

NET REDUCTION OF MISMATCH ERRORS   25.45DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00020	-.00000
2	0.00000	0.00000	-.00207	.00000
3	0.00000	0.00000	.00570	-.00000
4	0.00000	0.00000	-.00958	.00000
5	0.00000	0.00000	.00952	-.00000
6	0.00000	0.00000	.00350	.00000
7	0.00000	0.00000	-.00359	-.00000
8	1.00000	0.00000	1.00879	.00000
9	0.00000	0.00000	-.00611	-.00000
10	0.00000	0.00000	-.00326	.00000
11	0.00000	0.00000	-.00108	-.00000
12	0.00000	0.00000	-.00082	.00000
13	0.00000	0.00000	-.00016	-.00000
14	0.00000	0.00000	-.00042	.00000
15	0.00000	0.00000	.00008	-.00000
16	0.00000	0.00000	-.00013	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 27 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.62	.00	-.02	-.00	-39.37	-86.11	.62	.02
20.0	-.73	-.00	-.03	.00	-37.55	-84.57	.72	.03
25.0	-.78	-.00	-.03	.00	-37.10	-81.15	.78	.03
30.0	-.76	.01	-.02	.00	-38.17	-73.47	.78	.02
35.0	-.73	.00	-.02	-.00	-38.18	-78.10	.73	.02
40.0	-.65	-.00	-.01	-.00	-38.73	-77.59	.65	.01
45.0	-.54	-.01	-.01	.00	-40.49	-75.14	.54	.01
50.0	-.40	-.00	-.00	-.00	-43.91	-82.74	.39	.00
55.0	-.20	.01	.00	.00	-49.50	-70.69	.22	-.00
60.0	0.00	-.00	0.00	.00	-200.00	-79.38	-.00	.00
65.0	.29	.01	-.01	-.00	-45.65	-69.90	-.27	.01
70.0	.54	-.02	-.04	-.00	-40.13	-66.85	-.57	.04
75.0	.83	.02	-.08	.00	-35.86	-71.59	-.82	.08
80.0	.93	-.01	-.14	.00	-32.81	-66.46	-.93	.14
85.0	.86	-.00	-.21	.00	-30.89	-74.65	-.56	.21
90.0	.58	.03	-.28	-.01	-30.24	-62.26	-.55	.27
95.0	.05	-.00	-.31	-.00	-30.83	-72.84	-.05	.31
100.0	-.55	-.03	-.30	.00	-31.25	-65.08	.52	.30
105.0	-1.01	-.02	-.24	.01	-33.31	-60.57	.99	.25
110.0	-1.14	.07	-.16	-.01	-37.27	-62.52	1.21	.15
TOTAL	.68	.02	.14	.00	-34.58	-68.18		

NET REDUCTION OF MISMATCH ERROR: 33.60DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00056	-.00000
2	0.00000	0.00000	-.00222	-.00000
3	0.00000	0.00000	.00603	-.00000
4	0.00000	0.00000	-.01152	-.00000
5	0.00000	0.00000	.01061	-.00000
6	0.00000	0.00000	-.00020	-.00000
7	0.00000	0.00000	-.00521	-.00000
8	1.00000	0.00000	1.00964	-.00000
9	0.00000	0.00000	-.00898	-.00000
10	0.00000	0.00000	-.00102	.00000
11	0.00000	0.00000	-.00145	-.00000
12	0.00000	0.00000	-.00026	-.00000
13	0.00000	0.00000	-.00056	-.00000
14	0.00000	0.00000	.00009	-.00000
15	0.00000	0.00000	-.00021	-.00000
16	0.00000	0.00000	.00052	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 28 WITH 16 TAPS
FOR A TAP SPACING OF .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.47	-.11	.01	-.01	-41.82	-54.10	.36	-.02
20.0	-.35	.11	.02	.01	-43.76	-52.46	.46	-.00
25.0	-.47	.05	-.01	-.00	-41.77	-61.51	.51	.01
30.0	-.60	-.07	-.02	-.01	-40.26	-57.06	.53	.01
35.0	-.56	-.07	-.01	-.00	-40.11	-58.66	.52	.01
40.0	-.45	.04	.00	.01	-42.02	-58.47	.49	.01
45.0	-.40	.03	-.00	-.00	-43.14	-64.14	.43	-.00
50.0	-.37	-.03	.00	-.00	-44.42	-66.53	.35	-.00
55.0	-.18	.02	-.00	-.00	-50.64	-67.33	.20	-.00
60.0	0.00	-.01	0.00	.01	-200.00	-62.85	-.01	.01
65.0	.26	-.00	-.05	-.01	-44.96	-62.47	-.26	.02
70.0	.50	-.02	-.06	-.00	-39.74	-68.93	-.51	.06
75.0	.70	-.00	-.10	.01	-36.05	-64.02	-.70	.11
80.0	.76	.01	-.18	.00	-32.12	-73.18	-.75	.18
85.0	.63	.03	-.26	.00	-29.99	-64.98	-.60	.26
90.0	.25	.01	-.33	-.01	-29.07	-64.16	-.24	.33
95.0	-.45	-.13	-.37	-.00	-29.31	-64.23	.32	.36
100.0	-.84	.11	-.34	.01	-29.90	-55.74	.95	.35
105.0	-1.51	-.01	-.27	.01	-31.44	-64.68	1.50	.28
110.0	-1.80	-.04	-.19	-.01	-34.28	-63.07	1.76	.18
TOTAL	.71	.06	.17	.01	-33.84	-58.27		

NET REDUCTION OF MISMATCH ERROR= 24.43DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00056	.00000
2	0.00000	0.00000	-.00325	-.00000
3	0.00000	0.00000	.00753	.00000
4	0.00000	0.00000	-.01262	-.00000
5	0.00000	0.00000	.00967	.00000
6	0.00000	0.00000	.01172	-.00000
7	0.00000	0.00000	-.00093	.00000
8	1.00000	0.00000	1.01812	-.00000
9	0.00000	0.00000	.00014	.00000
10	0.00000	0.00000	-.00325	-.00000
11	0.00000	0.00000	.00067	.00000
12	0.00000	0.00000	-.00080	-.00000
13	0.00000	0.00000	.00046	.00000
14	0.00000	0.00000	-.00043	-.00000
15	0.00000	0.00000	.00019	.00000
16	0.00000	0.00000	-.00010	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 29 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.50	.02	-.23	.00	-31.41	-67.87	.61	.23
20.0	-.81	-.02	-.21	-.00	-30.90	-68.18	.78	.21
25.0	-.93	-.01	-.19	.00	-31.32	-72.96	.92	.19
30.0	-1.00	.01	-.17	.00	-32.60	-72.08	1.01	.17
35.0	-1.03	.00	-.14	-.00	-32.91	-88.25	1.03	.14
40.0	-.96	.02	-.10	-.00	-33.72	-70.55	.97	.10
45.0	-.82	.02	-.07	.00	-35.76	-67.59	.84	.07
50.0	-.73	-.09	-.04	-.00	-37.99	-56.35	.64	.04
55.0	-.33	.04	-.02	.00	-44.95	-64.43	.36	.02
60.0	0.00	.01	0.00	.00	-200.00	-70.20	.01	.00
65.0	.43	.02	-.00	-.00	-42.38	-69.19	-.42	-.00
70.0	.91	.02	-.02	-.00	-36.35	-64.98	-.89	.02
75.0	1.24	-.19	-.07	-.00	-33.37	-57.02	-1.33	.07
80.0	1.63	.01	-.14	.00	-29.70	-66.59	-1.62	.14
85.0	1.68	.03	-.23	.00	-27.98	-65.09	-1.66	.24
90.0	1.41	.04	-.33	-.00	-27.60	-62.04	-1.37	.33
95.0	.77	-.03	-.39	-.00	-28.47	-64.72	-.79	.39
100.0	.03	-.04	-.39	.00	-29.25	-63.59	-.07	.40
105.0	-.64	-.04	-.33	.01	-31.80	-62.83	.61	.34
110.0	-.91	.12	-.23	-.01	-36.22	-58.79	1.03	.22
TOTAL	.95	.05	.20	.00	-31.24	-62.48		

NET REDUCTION OF MISMATCH ERRORS   31.24DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00053	-.00000
2	0.00000	0.00000	-.00254	.00000
3	0.00000	0.00000	.00748	-.00000
4	0.00000	0.00000	-.01237	.00000
5	0.00000	0.00000	.01389	-.00000
6	0.00000	0.00000	.00532	.00000
7	0.00000	0.00000	-.00381	-.00000
8	1.00000	0.00000	1.01278	.00000
9	0.00000	0.00000	-.00866	-.00000
10	0.00000	0.00000	-.00493	.00000
11	0.00000	0.00000	-.00086	-.00000
12	0.00000	0.00000	-.00147	.00000
13	0.00000	0.00000	-.00045	-.00000
14	0.00000	0.00000	-.00042	.00000
15	0.00000	0.00000	-.00012	-.00000
16	0.00000	0.00000	-.00026	.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 30 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR (DEGREES)		AMPLITUDE ERROR (DB)		TOTAL MS ERROR (DB POWER)		FILTER PHASE (DEGREES)	FILTER AMPL. (DB)
(HZ)	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-1.02	-.02	-.05	-.00	-34.82	-68.49	1.00	.05
20.0	-1.13	.00	-.05	.00	-33.66	-77.99	1.13	.05
25.0	-1.14	.04	-.04	.00	-33.87	-62.18	1.17	.05
30.0	-1.18	-.02	-.04	-.00	-34.35	-65.59	1.16	.04
35.0	-1.12	-.02	-.03	-.00	-34.46	-67.98	1.10	.02
40.0	-.99	.00	-.01	-.00	-35.18	-87.19	.99	.01
45.0	-.78	.04	-.01	-.00	-37.32	-63.14	.82	.01
50.0	-.65	-.05	.01	.01	-39.55	-59.85	.60	-.00
55.0	-.34	-.01	.00	-.00	-45.07	-71.18	.34	-.00
60.0	0.00	.02	0.00	.00	-200.00	-66.18	.02	.00
65.0	.36	.03	-.03	-.00	-42.99	-63.02	-.33	.02
70.0	.67	-.03	-.07	-.00	-37.47	-64.28	-.70	.07
75.0	.97	-.04	-.13	.00	-33.63	-61.74	-1.01	.13
80.0	1.18	.00	-.21	.00	-29.90	-68.01	-1.17	.22
85.0	1.11	.03	-.30	.00	-28.00	-63.63	-1.08	.31
90.0	.75	.04	-.39	-.01	-27.40	-57.67	-.70	.38
95.0	-.00	-.08	-.42	-.00	-28.23	-58.71	-.08	.42
100.0	-.65	.00	-.40	.01	-28.83	-66.60	.65	.41
105.0	-1.30	-.02	-.32	.01	-31.00	-62.87	1.28	.33
110.0	-1.51	.08	-.21	-.01	-34.81	-60.24	1.59	.20
TOTAL	.93	.04	.19	.00	-51.70	-62.37		

NET REDUCTION OF MISMATCH ERROR=   30.67DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.07472	-.00000
2	0.00000	0.00000	-.40668	.00000
3	0.00000	0.00000	-.27651	-.00000
4	0.00000	0.00000	-.49417	.00000
5	0.00000	0.00000	-.21496	-.00000
6	0.00000	0.00000	-.59706	.00000
7	0.00000	0.00000	.08371	-.00000
8	1.00000	0.00000	-.56636	.00000
9	0.00000	0.00000	-.18847	-.00000
10	0.00000	0.00000	-.59286	.00000
11	0.00000	0.00000	-.12385	-.00000
12	0.00000	0.00000	-.54377	.00000
13	0.00000	0.00000	-.02685	-.00000
14	0.00000	0.00000	-.52292	-.00000
15	0.00000	0.00000	-.11162	.00000
16	0.00000	0.00000	-.19456	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 31 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	218.54	36.42	.19	-1.43	5.36	-4.7	-182.12	-1.62
20.0	67.16	36.32	-.20	-5.60	.91	-3.47	-30.83	-5.59
25.0	39.64	20.04	.01	-.08	-3.43	-9.27	-19.61	-.09
30.0	-18.64	-22.89	.75	-1.85	-9.96	-8.68	-4.25	-2.60
35.0	-66.71	-11.13	.26	-6.19	.56	-5.96	55.58	-6.45
40.0	-87.24	-348.94	-.13	-3.09	2.78	-9.32	-261.70	-2.96
45.0	-238.85	-131.88	.00	-3.00	4.76	3.83	106.97	-3.00
50.0	244.41	-12.44	.61	-7.83	4.15	-5.03	-256.85	-8.44
55.0	-65.42	-52.80	.56	-17.70	.40	-1.23	12.63	-18.26
60.0	0.00	-21.11	0.00	-10.41	-200.00	-2.77	-21.11	-10.41
65.0	-265.22	98.11	-.01	-9.79	3.39	.82	363.34	-9.78
70.0	215.34	-92.57	.52	-8.61	5.39	.21	-307.91	-9.13
75.0	-40.46	-307.74	.60	-5.85	-3.44	-2.54	-267.29	-6.45
80.0	-67.53	51.13	-.05	-4.48	1.01	-2.06	118.67	-4.44
85.0	194.21	-33.49	-.17	-4.23	5.99	-4.41	-227.71	-4.07
90.0	-184.19	305.57	.69	-5.72	5.71	-2.42	489.76	-6.42
95.0	-27.51	60.52	1.81	-9.68	-6.56	-2.83	88.02	-11.49
100.0	-68.10	317.20	2.16	-8.56	.12	-4.43	385.31	-10.73
105.0	-254.87	70.52	3.69	-13.21	2.65	-5.99	325.39	-16.90
110.0	-194.80	11.12	5.89	2.34	3.58	-14.20	205.92	-3.55
TOTAL	156.55	152.58	2.05	3.67	3.16	-1.87		

NET REDUCTION OF MISMATCH ERROR=   5.03DB.

PROGRAM FOR EVALUATING FILTER MATCH

FILTER COEFFICIENTS

1	0.00000	0.00000	.00108	.00000
2	0.00000	0.00000	-.00464	-.00000
3	0.00000	0.00000	.01058	.00000
4	0.00000	0.00000	-.01735	-.00000
5	0.00000	0.00000	.01423	.00000
6	0.00000	0.00000	.00825	-.00000
7	0.00000	0.00000	-.00411	.00000
8	1.00000	0.00000	1.02062	-.00000
9	0.00000	0.00000	-.00463	.00000
10	0.00000	0.00000	-.00116	-.00000
11	0.00000	0.00000	-.00102	.00000
12	0.00000	0.00000	.00012	-.00000
13	0.00000	0.00000	-.00014	.00000
14	0.00000	0.00000	.00024	-.00000
15	0.00000	0.00000	.00007	.00000
16	0.00000	0.00000	.00007	-.00000

CORRECTION FILTER FOR RECEIVERS 1 AND 32 WITH 16 TAPS
FOR A TAP SPACING OF   .0040 SECS.

FREQ	PHASE ERROR		AMPLITUDE ERROR		TOTAL MS ERROR		FILTER PHASE	FILTER AMPL.
(HZ)	(DEGREES)		(DB)		(DB POWER)		(DEGREES)	(DB)
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER		
15.0	-.58	.02	-.16	.00	-33.77	-71.69	.60	.16
20.0	-.80	-.02	-.16	-.00	-32.75	-68.23	.78	.16
25.0	-.92	.01	-.14	.00	-32.89	-67.99	.94	.15
30.0	-1.05	-.02	-.13	-.00	-33.29	-66.45	1.03	.13
35.0	-1.06	-.00	-.11	.00	-33.49	-74.05	1.06	.11
40.0	-.98	.02	-.08	.00	-34.17	-67.25	1.00	.08
45.0	-.83	.03	-.06	-.00	-35.97	-63.56	.87	.06
50.0	-.75	-.09	-.03	.00	-38.13	-56.87	.66	.03
55.0	-.39	-.01	-.02	-.00	-43.58	-70.27	.38	.01
60.0	0.00	.03	0.00	.01	-200.00	-61.35	.03	.01
65.0	.44	.04	-.01	-.00	-42.05	-62.12	-.40	.01
70.0	.86	-.02	-.05	-.01	-36.35	-64.11	-.88	.05
75.0	1.26	-.07	-.11	.00	-32.54	-58.93	-1.33	.11
80.0	1.62	.00	-.21	.00	-28.57	-75.86	-1.61	.21
85.0	1.60	.03	-.33	.01	-26.56	-61.65	-1.58	.34
90.0	1.19	.06	-.46	-.01	-25.76	-58.09	-1.13	.45
95.0	.23	-.08	-.54	-.00	-26.22	-58.83	-.31	.53
100.0	-.74	-.01	-.54	.00	-26.43	-70.52	.72	.54
105.0	-1.70	-.03	-.45	.01	-28.21	-61.88	1.67	.46
110.0	-2.13	.09	-.32	-.01	-31.56	-59.93	2.22	.31
TOTAL	1.09	.04	.25	.00	-29.97	-61.62		

NET REDUCTION OF MISMATCH ERROR=   31.65DB.

APPENDIX H

ADAPTIVE PROCESSING WIDE BANDWIDTH CONSIDERATIONS

APPENDIX H
WIDE BANDWIDTH CONSIDERATIONS

H.1 Background

The ability of a wide bandwidth system to successfully cancel strong spatial interference sources is examined. It is heuristically reasonable that a conventional sidelobe cancellor approach will have seriously degraded performance since zero's of the pattern, at a given frequency, will be displaced for other frequency components within the receiver passband.

Conclusions

● **Successful Adaptation**

An adaptive receiving array can successfully reject broadband interference from both point sources such as RFI and spatially extended sources such as auroral return.

● **Frequency-Spatial Equivalence**

A point source in a broadband system is mathematically equivalent to a spatially extended narrowband source, where the equivalent spatial distribution depends upon the receiver passband characteristics.

● **Additional Degrees of Freedom for Adaptation**

Since a broadband system senses broadband interference as an equivalent narrowband spatially extended source, more than one adaptive degree of freedom must be dedicated to such a source for successful spatial nulling. The number of degrees of freedom that must be utilized depends upon the bandwidth and strength of the source, the passband characteristics of the receiver, the length of the receiving array and the angle off boresite of the source.

● **Worst Case Design - Point Source**

The worst case occurs when the equivalent spatial spread of a wideband-noise like signal is maximized. This occurs in a PRS-like system when the full aperture is used at low frequency and the instantaneous receiver bandwidth is 100 KHz. In such a case, a maximum of two zero's, and hence two adaptive degrees of freedom are required to assure cancellation of a source spatially spread by $\Delta\theta_{max} = 2.6°$.

● **Aurora**

Spatially spread aurora can be modeled as a large number of spatially contiguous point scatterers. As such, the effect of 100 KHz bandwidth operation is to effectively further spread each edge of the aurora by $\Delta\theta_{max}/2 = 1.3°$. As such, the performance is degraded very little over what is achievable when operating with a lower bandwidth.

H.2 Analysis

Consider an N-element line array. Let the array lie along x-axis of (x,y, z) coordinate system and the position of the kth element of array be $\bar{a}_k = kd\bar{i}$, where $\bar{i}$ denotes a unit vector along x-axis, and (d) is the element spacing.

The incoming interfering signal has the discrete spectral representation

$$e(t) = \Sigma A_m \, e^{2\pi i f_m t} \tag{1}$$

where A_m denotes the complex amplitude of the mth spectral component. If this signal is transmitted from position

$$\bar{r} = x_o \bar{i} + y_o \bar{j} + f_o \bar{k} \, ,$$

then the signal at the kth element is $e(t - \tau_k)$ where τ_k is the time to transmit a radio wave from $\bar{r}$ to $\bar{a}_k$. Evidently

$$\tau_T = \frac{1}{c} \sqrt{(\bar{r} - \bar{a}_k) \cdot (\bar{r} - \bar{a}_k)}$$

$$= \frac{r}{c} \sqrt{1 - \frac{1}{r^2} [2(\bar{a}_k \cdot \bar{r}) - (\bar{a}_k \cdot \bar{a}_k)]} \tag{2}$$

$$\approx \frac{1}{c}(r) - \frac{1}{cr}(\bar{a}_k \cdot \bar{r})$$

is the far field approximation, where $(\bar{a}_k \cdot \bar{r})$ denotes the scalar product of position vectors $\bar{a}_k$ and $\bar{r}$ is,

$$(\bar{a}_k \cdot \bar{r}) = Kd \; r \; \sin \theta_o \tag{3}$$

where θ_o is azimuth from boresite (the y-axis direction). Combining (1), (2) and (3), the signal at the kth element is approximately

$$s(t - \tau_k) = \Sigma A_m e^{j2\pi i f_m(t-\tau_k)}$$

$$= \Sigma A_m e^{j2\pi i f_m(t - \frac{r}{c} + kd \sin \theta_o)}$$

$$= \Sigma A_m e^{j2\pi i f_m(t' + kd \sin \theta_o)}$$

where $t' = t - r/c$, the "retarded" time. Replacing t' by t, the interference arriving at the kth element from direction θ_o in the far field is

$$S_k(t) = \Sigma A_m e^{j2\pi i f_m(t + kd \sin \theta_o)} \tag{4}$$

In the limit spectral representation (4) can be shown to be equivalent to spectral representation

$$S_k(t) = \int_0^\infty e^{j2\pi i f(t + kd \sin \theta_o)} d\alpha(t) \tag{5}$$

with $\alpha(t)$, a stochastic process of orthogonal increments with the properties

$$E\overline{\alpha}(t') \alpha(t) = G(t) \delta(t'-t) dt$$

$$E\alpha(t') \alpha(t) = 0$$

where E is expected value operator, $\delta(t)$ is the Dirac delta function, and $G(f)$ is the one-sided power spectrum. If the spectrum of the interference is band limited to interval $- w/2 + f_o < f < w/2 + f_o$ where f_o is the center frequency and v is bandwidth, then the spectral representation in the form of (5) reduces to

$$S_k(t) = \int_{-w/2 + f_o}^{w/2 + f_o} e^{2\pi i f(t + kd \sin \theta_o)} d d(f)$$

$$= e^{2\pi i f_o t} \int_{-w/2}^{w/2} e^{2\pi i f(t + kd \sin \theta_o)} d (f + f_o) \quad (6)$$

by a simple change of variable. If one expands $e^{2\pi i f t}$ as a Fourier series on the interval $-w/2 < + < w/2$, i.e.

$$e^{2\pi i f t} = \sum_{n=-\infty}^{\infty} e^{2\pi i n/w} \left[\frac{\sin \pi w (t - n/w)}{\pi w (t - n/w)} \right]$$

Then (6) is equivalent to the well known sampling theorem

$$S_k(t) = \sum_{n=-\infty}^{\infty} S_k(n/w) \left[\frac{\sin \pi w (t - n/w)}{\pi w (t - n/w)} \right] \quad (7)$$

This theorem shows that the sampling interval for the complex signal at the kth antenna element need be no less than

$$T = 1/w$$

Now at each sampling time, i.e., $t_n = n/w$ for some n, an antenna beam is the sampled data filter

$$\mu = \sum_{i=1}^{n} \bar{w}_k x_t \quad (9)$$

where x_k is the signal at the kth antenna element at time $t_n = n/w$ and $\bar{w}_k$ are the antenna weights. If the interference in direction θ_o were a single sine wave of frequency f_o, then by (4), the interference part of x_k would be

$$S_k(n/w) = A \ e^{2\pi i f_o(n/w + kd \sin \theta_o)} \tag{10}$$

for $k = 1, 2, \ldots N$. In order to reduce the magnitude of interference (10) in the antenna (9) one must choose the weights w_k in (9) so that a zero of the pattern tends to cancel interference (10), i.e., so that

$$A \sum_{i=1}^{n} \overline{w}_k \ e^{2\pi i f_o \ kd \sin \theta_o}$$

is small, and have at the same time a main beam which still points in the desired direction.

If the interference is broad band, by (4)

$$S_k(n/w) = \sum A_m \ e^{2\pi i (f_m \ n/w + kd \sin \theta_o)}$$

$$= \sum B_m \ e^{2\pi i f_m \ kd \sin \theta_o} \tag{11}$$

where B_m are the complex numbers

$$B_m = A_m \ e^{2\pi i f_m(n/w)}$$

Evidently the component of (11), related to frequency f_m, can be referenced to the center frequency f_o as follows

$$S_k(n/w) = \sum B_m e^{2\pi i f_m \ kd \sin \theta_o}$$

$$= \sum B_m \ e^{2\pi i f_o(f_m/f_o) \ kd \sin \theta_o}$$

$$= \sum B_m \ e^{2\pi i f_o \ kd \sin \theta_o(m)} \tag{12}$$

This suggests a possible replacement of the frequency dependence f_m by an angular dependence defined by

$$\sin \theta_0(m) = \left(\frac{f_m}{f_0}\right) \sin \theta_0$$

$$= \left(\frac{f_0 + (f_m - f_0)}{f_0}\right) \sin \theta_0$$

$$= \sin \theta_0 + \left(\frac{f_m - f_0}{f_0}\right) \sin \theta_0 \qquad (13)$$

If one lets $\theta_0(m) = \theta_0 + \Delta\theta_m$ and assumes $((f-f_0)/f_0)$ is small, then by Taylor's expansion

$$\sin (\theta_0 + \Delta\theta_m) = \sin \theta_0 + (\cos \theta_0) \Delta\theta_m$$

$$+ \text{ higher order terms.}$$

Form this one can see by (13) that

$$\Delta\theta_m = \left(\frac{f_m - f_0}{f_0}\right) \tan \theta_0$$

Substituting in (12) yields

$$S_k(n/v) = \sum B_m \, e^{2\pi i f_0 kd \sin} \left[\theta_0 + \frac{(f_m - f_0)}{f_0} \tan \theta_0\right] (14)$$

This is the desired mapping of the frequency components of the interference into an equivalent angular interference pattern coming in directions

$$\theta_0(m) = \theta_0 + \left|(f_m - f_0)/f_0\right| \tan \theta_0 \qquad (15)$$

corresponding to the frequency f_m.

In order to minimize interference in the form of (14), one must place, by adaptivity or otherwise, a set of antenna nulls over the angular region

occupied by the directions $\theta_o(m)$, given in (15). The angular extent of this region about θ_o is bounded by

$$\Delta\theta = \max_m \left| \theta_o(m) - \theta_o \right|$$

$$= \max_m \frac{(f_m - f_o)}{f_o} \tan \theta_o$$

$$= \frac{\Delta f}{f_o} \tan \theta_o$$

If f_o is at the center of the interference band of bandwidth w, then

$$\underline{\Delta\theta = (w/2f_o)\tan \theta_o} \qquad (16)$$

This is the angular extent of the interference when mapped from frequency into the angular domain by (14).